

**Identification of high-risk communities for schistosomiasis in Africa:
A multicountry study**

Prepared by: The Red Urine Study Group

**Final report of a project supported by
the TDR Social and Economic Research component**

TDR



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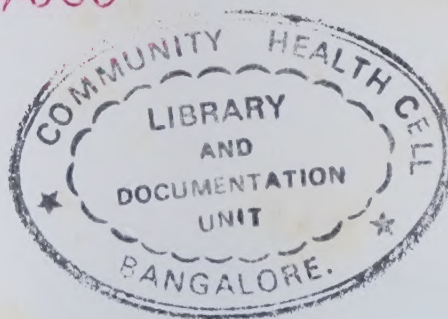
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Foreword

The UNDP/WORLD BANK/WHO Special Programme for Research and Training in Tropical Diseases (TDR) is a globally coordinated effort to bring the resources of modern science to bear on the control of major tropical diseases: malaria, schistosomiasis, filariasis (including onchocerciasis), the trypanosomiasis (both African sleeping sickness and the American form, Chagas' disease), the leishmaniasis and leprosy. The Programme has two interdependent objectives:

- To develop new methods of preventing, diagnosing and treating selected tropical diseases, methods that would be applicable, acceptable and affordable by developing countries, require minimal skills or supervision and be readily integrated into the health services of these countries;
- To strengthen -- through training in biomedical and social sciences and through support to institutions -- the capability of developing countries to undertake the research required to develop these new disease control technologies.

The *Social and Economic Research Project Reports* series represents a communication venture undertaken by TDR's Social and Economic Research (SER) component. This series was launched in 1987 to facilitate and increase communication among social scientists and researchers in related disciplines carrying out research on social and economic aspects of tropical diseases and to disseminate social and economic research results to disease control personnel and government officials concerned with improving the effectiveness of tropical disease control.

Research reports published in this series are final reports of projects funded by TDR and usually include more material than ordinarily published in peer review journal articles. TDR considers this material to be valuable both for investigators involved in the study of social and economic aspects of tropical diseases and for professionals involved in training programmes in the social sciences, economics and public health. The series should acquaint those working on similar problems with approaches undertaken by others, in order to test new approaches in different settings, and should provide useful information to personnel in disease control programmes and related agencies.

Although SER, as of 1 January 1994, was integrated into an Applied Field Research (AFR) component of the TDR Programme, the AFR Steering Committee considers that the series deserves to be continued so that results of the social and economic research in TDR will continue to be disseminated.

In the interests of rapid dissemination of social and economic research findings, much of the supporting material, e.g., tabulated data, has not been included in the present report. This material is, however, available upon request to interested researchers. All requests for such material, citing in full the number, title and author(s) of the *SER Project Report*, should be addressed to: Dr C. Vlassoff, Secretary, Manager, Gender and Tropical Diseases Task Force, TDR, World Health Organization, 1211 Geneva 27, Switzerland.

Tore Godal, Director

Special Programme for Research
and Training in Tropical Diseases
TDR

PREFACE

Schistosomiasis is a chronic and debilitating disease, believed to affect about 200 million people world wide. Nearly 90% of cases are found in Africa. Although clearly related to water sources, its distribution is very focal and neighbouring communities in apparently similar ecological situations can vary in terms of prevalence, the intensity of infection and the clinical symptoms associated with infection. The first question that must be answered in developing a control strategy - whether that strategy is based on passive detection and treatment through primary health care or a more active system - is where the people with high levels of schistosomiasis-related morbidity are located. Until recently, the only reliable means of answering this question has involved microscopically testing urine or stool samples, something which is expensive and may have inhibited the development of control activities in a number of countries.

This paper reports on a low cost method of identifying schools and communities with high levels of schistosomiasis-related morbidity. The method involves sending questionnaires to primary schools through normal administrative channels, in which children are asked about the symptoms and diseases they have suffered in the recent past. It involves active collaboration between education and health departments using an approach which was initially developed in Tanzania by researchers working in collaboration with the Swiss Tropical Institute. This report concerns a large scale validation exercise in seven other African countries with varying levels of schistosomiasis prevalence. The focus is on *S. haematobium* (urinary schistosomiasis), although the study found some evidence that the approach may also be useful with *S. mansoni* (intestinal schistosomiasis). The "indirect questionnaire" approach proved to be an extremely accurate way of identifying low risk schools, thereby allowing control to concentrate initially on schools and community with the highest levels of morbidity. It is also much less costly than other ways of mapping out high risk communities, and offers great hope to countries which have not yet identified the communities in which the disease is a major priority. One additional benefit of the approach is that it allows an assessment of health priorities perceived by the community, as reported by key informants (school teachers). This allows policy makers to consider the priority that should be given to schistosomiasis control in relation to other health problems in the community.

This report summarizes the diagnostic accuracy of the indirect questionnaires as a means of identifying communities (not individuals) with a high risk of urinary schistosomiasis. It also reports on the costs of using the technique and provides a detailed account of the organizational and administrative experience of distributing and collecting the questionnaires in the seven participating countries, including the degree of collaboration between the different government departments. The experience of all the teams involved in the present study has also been synthesized into a companion volume - a short Guide designed to provide concise, step-by-step, instructions to using the technique. The "Guide for the Rapid Identification of Communities with a High Prevalence of Urinary Schistosomiasis" is available from TDR in both English and French.

D. B. Evans and C. Vlassoff, Applied Field Research Group, TDR
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Schistosomiasis is a chronic and debilitating disease, believed to affect about 200 million people world wide. Nearly 90% of cases are found in Africa. Although clearly related to water sources, its distribution is very local and neighbouring communities in apparently similar ecological situations can vary in terms of prevalence, the intensity of infection and the clinical symptoms associated with infection. The first question that must be answered in developing a control strategy - whether that strategy is based on passive detection and treatment through primary health care or a more active system - is where the people with high levels of schistosomiasis-related morbidity are located. Until recently, the only reliable means of answering this question has involved mass-screening, testing urine or stool samples, something which is expensive and may have inhibited the development of control activities in a number of countries.

This paper reports on a low-cost method of identifying schools and communities with high levels of schistosomiasis-related morbidity. The method involves sending questionnaires to primary schools through normal administrative channels, in which children are asked about the symptoms and diseases they have suffered in the recent past. It involves active collaboration between education and health departments using an approach which was initially developed in Tanzania by researchers working in collaboration with the Swiss Tropical Institute. This report concerns a large scale school-based survey in seven other African countries with varying levels of schistosomiasis prevalence. The focus is on 2 communities (primary schoolchildren) although the study found some evidence that the approach may also be useful with 2 secondary educational establishments. The "indirect questionnaire" approach proved to be an extremely accurate way of identifying low risk schools, thereby allowing control to concentrate primarily on schools and communities with the highest levels of morbidity. It is also much less costly than other ways of mapping out high risk communities, and offers great hope to countries which have not yet identified the communities in which the disease is a major priority. One additional benefit of the approach is that it allows an assessment of health facilities provided by the community, as reported by key informants (school teachers). The authors hope readers to consider the policy that should be given to schistosomiasis control in relation to other health problems in the community.

This report summarizes the design, the survey of the indirect questionnaire as a means of identifying communities with high levels of morbidity, and provides a detailed account of the organizational aspects of using the technique and provides a detailed account of the organizational and administrative experience of identifying and collecting the questionnaires in the seven participating countries, including the degree of collaboration between the different government departments. The experience of all the teams involved in the present study has also been synthesized into a companion volume - a short Guide designed to provide concise, step-by-step instructions to using the technique. The "Guide for the Rapid Identification of Communities with a High Prevalence of Urinary Schistosomiasis" is available from ILS in both English and French.

ACKNOWLEDGEMENTS

Many people have contributed to the success of the present study, and they all deserve our heartfelt thanks for their contribution. The study participants would like to thank particularly the following people and institutions:

The UNDP/WORLD BANK/WHO Special Programme for Research and Training in Tropical Diseases (TDR), which provided funding and logistical support for this large study through its Social and Economic Research (SER) Steering Committee (SC). We are grateful to the Steering Committee (SC) members and the chairman, Prof. B. Singer, for their confidence in us, and to Dr. C. Vlassoff, the permanent secretary of the SC, for her unfailing commitment. Dr. U. Blumenthal (London School of Hygiene and Tropical Medicine) provided a valuable input at the first Yaoundé workshop as SC representative.

The Swiss Tropical Institute (STI) Basel, also provided material and logistic support. Our special gratitude goes to Prof. M. Tanner, Head of the Department of Public Health and Epidemiology of the STI, for the major role he played in the birth and life of this project. He offered the Technical Adviser (TA) a friendly base for efficient work.

The Institut de Formation et de Recherche en Démographie (IFORD) in Yaoundé was the central base of the study, and the home of the Principal Investigator (PI) and the permanent secretariat. It also hosted the first workshop and was instrumental in giving the study cohesion and success.

The Community Health Sciences Unit of the Malawi Ministry of Health hosted the second workshop in Lilongwe, and the dedicated work of Dr. L. Chitsulo and the late Mrs. D. Momba ensured its success.

We should also like to thank Jennifer Jenkins, of the Swiss Tropical Institute, for her skilled editing of the present document.

Finally, we remember warmly all the people who are usually referred to as "study participants". They were the heart, body and arms of the study, and we hope that by giving them tools to deal with their own health problems we contributed to improving their lives.

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Many people have contributed to the success of the present study, and they all deserve our heartfelt thanks for their contribution. The study participants would like to thank particularly the following people and institutions:

The INTERWORLD BANK/WHO Special Programme for Research and Training in Tropical Diseases (ITRD), which provided funding and logistical support for this large study through its Social and Economic Research (SER) Steering Committee (SC). We are grateful to the Steering Committee (SC) members and the chairman, Prof. R. Singer, for their confidence in us, and to Dr. C. Vlasoff, the permanent secretary of the SC, for her continuing commitment. Dr. U. Bhattacharya (London School of Hygiene and Tropical Medicine) provided a valuable input at the first Yaoundé workshop as SC representative.

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The Institut de Formation et de Recherche en Épidémiologie (IFORE) in Yaoundé was the central base of the study, and the base of the Principal Investigator (PI) and the permanent secretariat. It also hosted the first workshop and was instrumental in giving the study cohesion and success.

The Community Health Sciences Unit of the Minister's Ministry of Health hosted the second workshop in Libreville, and the dedicated work of Dr. L. Chibwe and the late Mrs. D. Mouna ensured its success.

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Finally, we remember warmly all the people who are usually referred to as "study participants". They were the heart, body and soul of the study, and we hope that by giving them tools to deal with their own health problems we contributed to improving their lives.

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The study participants are collectively members of the "Red Urine Study Group", under which name the overall results of the study are published.

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DATA OWNERSHIP

The data collected during the present multi-country study remains the property of the country teams.

The reported data cannot be used in further publications without the written consent of the country principal investigators (for each country the first name on the list above).

For more country-specific information, national reports can be requested either directly from the country investigators, or from Dr. D. Evans, WHO/TDR, World Health Organization, Via Appia, 1211 Geneva 27, Switzerland (after clearance from country investigators).

SUMMARY

The present study attempted to determine the applicability and usefulness of a new standard methodology for identifying communities at high risk of *S. haematobium* infection. The approach was first developed in Tanzania, and its feasibility and cost-effectiveness then assessed in seven African countries: Cameroon, Congo, Ethiopia, Malawi, Zaïre, Zambia and Zimbabwe. In a first step, simple questionnaires were distributed to primary schools through an existing administrative system and used for the identification of high-risk communities. (For urinary schistosomiasis there is good evidence that prevalence among school children will reflect the prevalence in the community as a whole.) In a second step, the results of the questionnaire survey were validated by reagent-stick testing for haematuria. This testing was carried out by primary school teachers, except in Zambia and Zaïre, where it was done by the research team. Treatment was provided for children found to be infected, to satisfy the ethical requirements of the study. In Zaïre, the second step included testing for *S. mansoni* infections.

Operationally, this methodology worked well in the seven countries, despite their very different socio-economic, political and administrative environments. A total of 67,290 children in 610 schools were initially screened with questionnaires (overall return rate: 89%, return times: 2-20 weeks). During the second phase, 38,595 children were screened with a biomedical test (32,471 with reagent sticks and 6,124 with Kato-Katz thick smears). The overall country haematuria prevalences in the seven countries ranged from 18.3% in Congo to 63.6% in Cameroon, confirming the differences in endemicity levels.

In five countries the correlation between the questionnaire results and the biomedical testing results was high ($p < 0.001$), and in one country, Zambia, the result was considered to be just acceptable. In Ethiopia there was not a satisfactory correlation. In the six countries where the approach was successful, high negative predictive values (85-97%) were achieved by the questionnaires. From the point of view of control activities, this indicated that low-risk communities could safely be identified by questionnaires. This information would make it possible to exclude such communities from control programmes, at least initially, so that available resources could be concentrated on communities where the risk was higher. Positive predictive values ranged from 52% to 75%. Reagent stick testing by the teachers was found to be accurate in the five countries in which the method was used, and the teachers' reports about their involvement in this para-medical activity were very positive.

The approach could form the basis of a community-based morbidity control programme. The identification of high-risk areas by pre-screening with questionnaires could be followed by mass chemotherapy in these areas, or by testing for infection followed by treatment. The testing could be done, as in the study, by schoolteachers using reagent sticks.

An important further objective of the study was to look at ways in which biomedical and social scientists can collaborate, in order to collect both quantitative and qualitative data. Each investigating team included a biomedical and a social scientist. The social science contribution helped to give the teams an additional insight into operational issues, mainly in relation to existing administrative systems, and it also helped to provide better descriptions of the dissimilar socio-economic environments in which the studies were conducted. Much valuable experience was obtained about how this type of collaboration could be improved in the future.

Finally, information was also collected from the teachers regarding disease priority patterns. This is an important aspect of community-based health work, and is often neglected in disease control programmes.



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APPENDIX

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TABLE XI. Summary of the results of the calculations.

TABLE XII. Summary of the results of the calculations.

LEGENDS TO FIGURES

- Figure 1: Map of Africa, with study sites. 1=Cameroon (Mayo Danay District), 2=Congo (Bouenza Region), 3=Ethiopia (Middle and Lower Awash Valley), 4=Malawi (Mangochi District), 5=Zaire (Zone de Songololo), 6=Zambia (Isoka District), 7=Zimbabwe (Makonde District). The white circles indicate the approximate location of the study area in each country.
- Figure 2: Overall study design of the TDR/SER multi-country study.
- Figure 3: Relation between the positivity rate of the children's answer "I had blood in my urine" and "I had schistosomiasis. The Zairian schools are emphasised as black dots.
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- Figure 7: Cumulative percentage (by rank) of the answer "schistosomiasis" as a disease that should be controlled, given by teachers in the 7 study countries.
- Figure 8: Relation, at the country level, between the overall haematuria prevalence rate and the percentages of teachers reporting "schistosomiasis" among the top 4 diseases (8a) and "blood in urine" among the top 4 symptoms of importance (8b).
NS=not significant. Cam=Cameroon, Con=Congo, Eth=Ethiopia,
Mal=Malawi, Zai1=Zaire S.haematobium, Zai2=Zaire S.mansoni,
Zam=Zambia, Zim=Zimbabwe.



TABLE OF ABBREVIATIONS

95 % CI	: 95 % Confidence Interval
CU	: Coordination Unit
DF	: Degrees of Freedom
Effic.	: Test Efficiency
MOH	: Ministry of Health
NA	: Not Applicable
ND	: Not Done
PHC	: Primary Health Care
PI	: Principal Investigator
PV +	: Positive Predictive Value
PV -	: Negative Predictive Value
RAP	: Rapid assessment procedure
TA	: Technical Adviser
TDR	: UNDP/WORLD BANK/WHO Special Programme for Research and Training in Tropical Diseases
TM	: Trade Mark
SC	: Steering Committee
SER	: Social and Economic Research
US \$: United States dollar
vs	: Versus
WHO	: World Health Organization

1. INTRODUCTION

1.1 Defining priorities

The setting of priorities in the health sector is often a reflection of international health goals, defined by international agencies, and direct links to locally prevailing problems are weak. A recent World Development Report on investment in health (World Bank, 1993) emphasizes the use of DALYs (Disability-Adjusted Life Years) as a standard measure of the burden of disease. This systematic approach to defining health problems, and the possibility that it offers for estimating the relative cost-effectiveness of a large range of interventions, has been a welcome addition to the set of health policy and planning tools available. The report re-emphasized the importance of preventive measures and limited packages of essential care, rather than high-level health care for a privileged few, and the analysis led to the conclusion that re-directing already available resources according to these priorities could lead the way to an overall improvement in the health status of populations.

The World Bank report did, however, have a very biomedical approach to the measurement of disease impact, particularly to the definition of "disability". Their approach ignored the fact that people have their own perceptions of disease, illness and disability, which may differ substantially from those of a body of international experts. In order to set priorities at the local level, one needs not only to include biomedical disability measurements such as infection rates and morbidity patterns, but also to take into account the population's own perceptions of health and disease (Heggenhougen & Shore, 1986; Tanner & de Savigny, 1987). Medically-assessed health needs and people's perceived needs may differ significantly (Kroeger, 1985).

Matching proposed control strategies with community disease perception is an important factor for ensuring the acceptability and sustainability of health interventions (Tanner, 1989a). It can be seen as a way of ensuring that the DALYs that are targeted by the intervention are those the community feels to be relevant. If the community members experience a significant alleviation of suffering, or other benefits, the motivation for them actively to support and sustain an intervention will be much higher. However, it is clear that not all the health problems that people perceive are amenable to technically feasible and cost-effective interventions, so situations have to be created in which health professionals and the members of the community can interact, in order to plan priorities according to what is feasible as well as what is desirable.

One approach to making decisions about health interventions is to obtain as detailed a picture as possible both of the health status of the community, and of the perception of its members of what problems exist, and which are most important. This was done, for example, in Tanzania in the 1980s, (Degrémont et al., 1987), and the information was used for planning and executing an integrated schistosomiasis control programme (Tanner et al., 1986; Suter et al., 1986). However, this comprehensive approach involved extensive surveys, and it would be too slow and costly to use on a large scale. More rapid and inexpensive approaches are required for assessing at community level which interventions should be given priority.

It is in this framework that there is a large potential area of application for rapid assessment procedures (RAP) (Vlassoff & Tanner, 1992). The term encompasses a large number of

techniques and methodologies, from simplified sampling designs to rapid anthropological procedures. Health interviews are among the procedures available.

1.2 Health interviews and questionnaires in community diagnosis

Experience with community diagnosis (Nichter, 1984; Degrémont et al., 1987), malaria (Jackson, 1985; Alonso et al., 1987) and schistosomiasis in Tanzania (Zumstein, 1983; Lwihula, 1985) and elsewhere (Kloos et al., 1982; Kloos et al., 1986) showed that many diseases and their main signs and symptoms are well recognized and perceived by community members, and that this knowledge offers an important source of information, which can be used, for example, for the setting of local priorities and for disease monitoring (Tanner & de Savigny, 1987).

The health interview survey is a tool that is able to tap this disease perception potential in a population, and provide a link between health professionals and community members. Such surveys have been used extensively in both developed and developing countries for assessing morbidity as perceived by community members, and to investigate the utilization patterns of health services (reviewed by Kroeger, 1983; Ross & Vaughan, 1986; Kalter, 1992). Interviews with the relatives of the deceased have also been used to obtain information about causes of death where detailed mortality statistics are not available (Gray, 1991; Snow and Marsh, 1992).

Health interviews are usually conducted by investigators or their field staff, in a more-or-less formal situation. The problem with this approach is that it is time-consuming and expensive. Recently, two studies were carried out in Tanzania to test a rapid assessment procedure to identify communities at high risk of schistosomiasis, in which face-to-face interviews were replaced by simple, self-administered questionnaires, which were distributed inexpensively through an existing administrative system. This method was able to reduce the time needed for community diagnosis, and reduce the expense, but still provided valuable information on both biomedical aspects and disease perception (Lengeler et al., 1991a & 1991b). In Tanzania, questionnaires were distributed mainly through the school system. Schoolteachers and pupils, and local political leaders, were asked short questions about diseases and symptoms occurring in their area. The adults were also asked about their priorities for disease control.

The method was called the "indirect interview approach" (Lengeler et al., 1991c). It worked very well operationally - return rates were more than 90% within 4 weeks. The diagnostic performance of the questionnaires in detecting schools in which the pupils were at a high risk of being infected with schistosomiasis was validated by comparison with a biomedical indicator, and found to be very good. The questionnaire completed by the teachers and local leaders also provided valuable information on local priorities. This particular study was carried out in the context of schistosomiasis control in Tanzania, but the methodology could be applied to a large range of diseases and health problems (Lengeler et al., 1992).

1.3 Schistosomiasis and its control

Schistosomiasis is a chronic and debilitating disease caused by liver flukes of the genus Schistosoma. Four species of schistosomes infect humans, causing distinct diseases although their transmission patterns are similar. Urinary schistosomiasis, due to S. haematobium, affects the lower abdomen and the genito-urinary tract. Intestinal schistosomiasis is due to the three other species, among which S. mansoni is the most important in Africa. The disease affects mainly the liver and the intestine. Overall, schistosomiasis affects about 200 million people, causing a significant burden of morbidity (WHO, 1993).

The transmission of schistosomiasis takes place only in those places where the freshwater snail vector is present, and there is also contact between the population and infected water. Its distribution is therefore very focal (Jordan & Webbe, 1982). For disease control, this means that comprehensive epidemiological investigations and mapping are necessary before rational decisions regarding interventions can be made. Most of the information currently available is summarized in the Atlas of the global distribution of schistosomiasis (Doumenge et al. 1987).

Because schistosomiasis is not associated essentially with an acute illness, but more with chronic debility with varying degrees of pain, it becomes a perceived public health problem only at a certain (community-specific) threshold. This threshold is probably the result of a complex interaction between prevalence and intensity of infection (and the resulting severity of morbidity), the cultural perception of the disease, and the spectrum of other diseases in the area.

In recent years, the emphasis in schistosomiasis control has shifted from transmission control, mainly by environmental and other vector control measures, to the control of morbidity in affected individuals. This change has largely been the result of the availability of new anti-schistosomal drugs that are safe and effective (WHO, 1993). More attention is now being devoted to identifying diseased individuals and offering them treatment. Small and large chemotherapy programmes have been set up, and they have achieved remarkable successes in bringing down disease rates. However, they have had little impact on transmission, and in most areas there have been high re-infection rates (Wilkins, 1989), leading to a need for re-treatment. This has given rise to an acute problem of sustainability (Korte & Mott, 1989).

One conclusion drawn from these experiences was that more still needs to be known about the development of morbidity in individuals, so that the most effective testing-and-treatment schedules can be worked out. A further conclusion is that chemotherapy programmes need to be developed that are community-based, to ensure the sustainability of morbidity control over long time periods. Following this line, PHC-based control programmes centred on chemotherapy have been set up, for example in Pemba Island (Savioli & Mott, 1990), Ethiopia (Gundersen et al., 1990), Zimbabwe (Chandiwana et al., 1991) and Mauritius (Dhunpath 1994).

1.4 Identification of high-risk areas using questionnaires; experience in Tanzania

As a general principle, it is more cost-effective to concentrate resources on detecting, treating and protecting people in high-risk areas for a disease than to screen and "protect" mostly uninfected individuals in low risk areas (Davis, 1989). The definition of a high-risk area can be done on the basis of an **intervention threshold**. This is the prevalence of schistosomiasis infection in a community above which the use of specific financial and human resources is justified. The intervention threshold for a disease can be defined according to disease prevalence, according to community priorities, or a combination of both.

Recent reviews of the medical and socio-economic impact of schistosomiasis (Gryseels, 1989; Tanner, 1989b) have pointed out that for both intestinal and urinary schistosomiasis, no simple biomedical criteria for defining the intervention threshold exist at present. The two Tanzanian studies mentioned above (Lengeler et al., 1991a, 1991b) offered an alternative approach for defining an intervention threshold, which was based on community perceptions of the prevalence and importance of the disease. In fact, when the perception of the disease by party leaders and school head teachers was compared with the results of parasitological surveys, it was found that once a particular prevalence rate of the disease had been reached - as measured by biomedical testing - almost all respondents placed urinary schistosomiasis among the "top four" diseases for control. A "high-priority threshold" could be defined on this basis. This method of setting thresholds involves considering the community's own priorities, and might prove very useful in the context of various PHC programmes.

Once the intervention threshold has been defined, a fast and cost-effective diagnostic strategy needs to be worked out, to classify community units (schools, hamlets, villages, administrative or other units) into "high risk" or "low risk" groups. In the latter, control can be restricted to passive case-detection within the existing health services (Rohde, 1989). In units in the "high risk" group, active case-detection and treatment, mass treatment or other control measures could be introduced. Gryseels and Polderman (1991) have described this approach as "selective at community level rather than at individual level". A recent publication has evaluated the comparative cost-effectiveness of these different approaches (Guyatt et al., 1994).

In the Tanzanian study, school questionnaires proved to be a fast and very low-cost method for preliminary, area-wide screening for high-risk areas for urinary schistosomiasis. The diagnostic performance of the questionnaires was validated by using a biomedical test for individual diagnosis, to obtain independent quantitative information about the prevalence of infection. It was found that the questionnaires could be reliably used to identify high- and low-risk schools. Since age-infection curves are similar in most endemic settings (Jordan & Webbe, 1982), the screening of schoolchildren was expected to give results representative for the whole community.

The validation step was carried out using reagent sticks to detect blood in urine. These have been shown to be highly specific for urinary schistosomiasis in children. They are less sensitive than urine filtration for detecting *S. haematobium* infections (Wilkins et al., 1979; Mott et al., 1985), but two studies (Murare & Taylor, 1987; Lengeler, 1989) showed that the missed cases were mostly very light infections (< 10 eggs/10 ml), and that reagent sticks were as good as urine filtration for detecting infections ≥ 50 eggs/10 ml. The sticks also had a

higher predictive value than urine filtration for macropathology, as seen with sonography (Hatz et al., 1990), and they are therefore valuable in an approach that stresses morbidity control. On Pemba Island (Savioli & Mott, 1989) and in Zimbabwe (Taylor et al., 1990) the operational value of reagent sticks for a PHC-based control programme was demonstrated.

1.5 Screening for infected individuals; use of reagent sticks by teachers.

The identification of high-risk communities is, of course, only a first step. The second step - unless mass-treatment is decided upon - is the identification of infected individuals so that they can be offered treatment. The Tanzanian study showed that testing for haematuria using reagent-sticks was a satisfactory procedure for this purpose. Furthermore, it was shown that this testing could be reliably carried out by primary school teachers who had been given special training beforehand (Lengeler et al. 1991b). This was the procedure used for the validation of the questionnaire approach, and it was shown that the teachers were willing to undertake testing, and carried it out reliably and at a low cost.

A two-step procedure was proposed, using questionnaires to identify communities at risk, followed by reagent-stick testing by the teachers, and treatment of those found positive by the nearest health service. This procedure was calculated to be 8 times cheaper than the more traditional approach in which a specialized team carries out tests and treatment.

The procedure has advantages in addition to those of economy. Since members of the community are involved in setting priorities, and in carrying out the reagent-stick testing, the programme is more likely to be sustainable. Asking teachers to do the reagent-stick testing means that health personnel need not be asked to perform systematic screening in addition to their normal clinical duties. It was found in an investigation in Tanzania (Ifakara Centre, unpublished results) that the health personnel performed poorly (inconsistent results, low compliance) when they were asked to test children attending their facilities systematically with reagent sticks .

1.6 Feasibility of the 2-step approach in other places: the Multi-Country Study

General objective of the study

Since the two-step methodology developed in Tanzania looked promising as a way of providing targeted treatment for schistosomiasis, a multi-country study was set up, supported by the UNDP/WORLD BANK/WHO Special Programme for Research and Training in Tropical Diseases (TDR), which provided the funding and logistical support for this large study through its Social and Economic Research (SER) Steering Committee. The primary purpose was to investigate the validity, feasibility and cost-effectiveness of the questionnaire method for identifying communities at high risk for urinary schistosomiasis, in other African countries. The study was carried out in seven African countries with different social, political and cultural systems and different levels of *S.haematobium* endemicity. In Zaire the performance of the questionnaire was tested in an area where intestinal as well as urinary schistosomiasis is prevalent.

In five countries, validation was carried out using reagent-stick testing by school teachers to identify infected individuals. The study thus also provided information about the feasibility of

the second step of the two-step procedure, screening by schoolteachers, in a number of different endemic settings.

Specific objectives of the study

- To provide comparative data on the cost and effectiveness of the questionnaire method for community diagnosis of urinary schistosomiasis at district level.
- To explore the suitability and value of different existing administrative systems for implementing a health-related activity.
- To assess the appropriateness of this methodology for health priority setting and disease control by existing administrative and health care structures, in a wider context.
- To provide examples of the interaction between biomedical and social scientists within research teams and to explore how this interaction could improve the outcome of applied field research.
- To increase the interaction between field-oriented scientists in Africa in both anglophone and francophone countries.

2. STUDY DESIGN AND METHODS

2.1 Study areas

The study areas are shown in the map in Fig.1, and are described in detail in Section 3.4. There were three francophone countries (Cameroon, Congo and Zaire) and four anglophone ones (Ethiopia, Malawi, Zambia and Zimbabwe). Two study sites were located in the Sahel region (Cameroon, Ethiopia), three were located in a savanna area (Malawi, Zaire, Zambia, Zimbabwe), and one in a forest area (Congo).

The studies were carried out in 1990 and 1991. These were eventful years throughout Africa. The main political and other events which influenced the study are mentioned in the reports on the individual countries in Chapter 3.

2.2 Overview of study design and methods

This section provides a brief overview of the study design and methodology. The procedure for collecting the data is described in more detail in the remaining sections in this chapter. Chapter 3 presents the results, and Chapter 4 discusses the use of the data to validate the procedure.

The design in all seven countries was based on that of the two original Tanzanian studies (Lengeler et al., 1992).

Step 1. Area-wide screening using questionnaires

Preparation of questionnaires and distribution to all schools in the area using existing administrative channels.

Calculation of the questionnaire positivity rate.

Step 2. Validation of the questionnaire results by biomedical testing

Testing for haematuria using dip-sticks.

Treatment of children found to be positive.

Calculation of the prevalence of schistosomiasis.

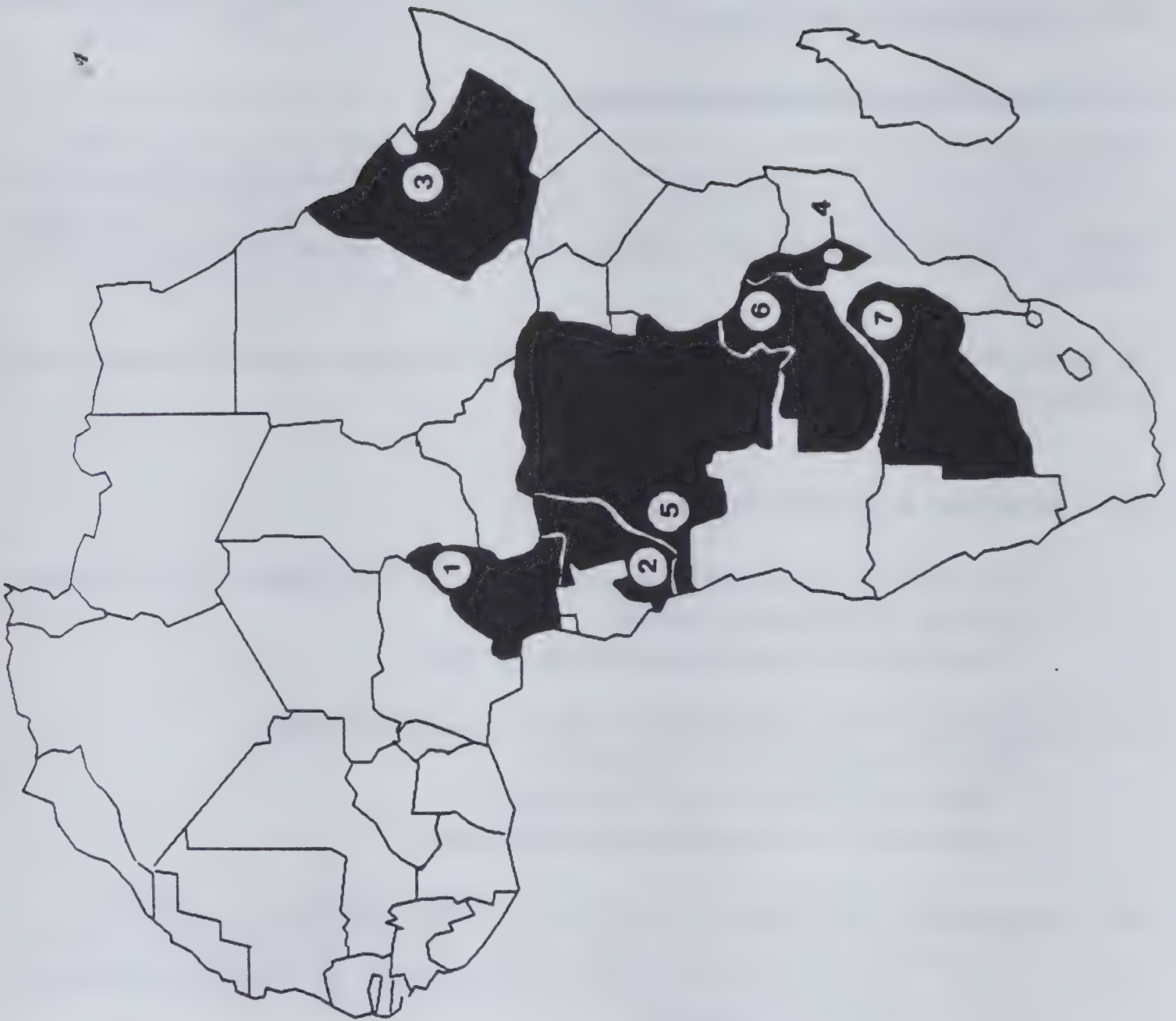
Step 3. Assessment of the diagnostic performance of the questionnaire procedure

Comparison of the questionnaire positivity rate and the prevalence, in order to examine the correlations between them and thus assess the diagnostic performance.

This is discussed in Chapter 4.

There were some differences in the details of the procedure in the various countries, because it needed to be adapted to each local situation. A summary of the various designs is given in Fig.2. The major difference was that in five countries validation by testing for haematuria was carried out by schoolteachers, and in two countries direct validation by the survey team was preferred (Section 2.7).

Figure 1



Study Sites

**1 = Cameroon; 2 = Congo; 3 = Ethiopia; 4 = Malawi;
5 = Zaire; 6 = Zambia; 7 = Zimbabwe.**

Figure 2

PHASES	Teacher validation (5 countries)	Direct validation (2 countries)
<u>1. Questionnaires</u> Sent to all schools (and party offices)	Cameroon: 113 schools Congo: 58 schools + party Ethiopia: 28 schools Malawi: 113 schools Zimbabwe: 121 schools	Zaire: 160 schools + party Zambia: 93 schools
<u>2. Ranking</u> Classification of the units	High priority Low priority	Ranking but no classification
<u>3. Selection</u>	30 schools selected randomly 30 schools selected randomly	60 schools selected randomly & visited by team with reagent sticks.
<u>4. Seminars</u> For schoolteachers Teaching/inform. distrib.of material	All 60 selected schools	+Kato-Katz in Zaire
<u>5. Validation</u> Reagent stick testing by schoolteachers	120 children/school tested by (head)teacher	
<u>6. Cross-checking</u> By team, with reagent sticks.	Same 120 children/school re-tested in 30 schools ----- + qualitative questionnaire	
<u>7. Treatment</u>	All examined schools	All examined schools

Study Designs

2.3 Study timetable and overall organization

Seven country teams were identified on the basis of a letter of intent in 1989. The project was developed during the second TDR Workshop on Networking for Tropical Diseases Field Research in Africa, held in Kadoma, Zimbabwe, from August 13 - 19, 1989. It was approved and funded by TDR in December 1989.

Timetable

July-August 1990:	Questionnaire design and pre-testing.
Sept. 1990 - Feb. 1991:	Fieldwork phase one (questionnaires).
March 1991:	First Workshop in Yaoundé (analysis phase one).
May - August 1991:	Fieldwork phase two (reagent stick testing by teachers; cross-checking).
September 1991:	Second Workshop in Lilongwe (data analysis).
April 1992:	Third Workshop in Saly Portudal, Senegal (reporting of results to the TDR Steering Committees on Schistosomiasis and on Social and Economic Research).

Coordination and Support Unit

A Coordination and Support Unit (CU) was set up with a Principal Investigator and a Technical Assisant. The Principal Investigator was based at the Institut de Formation et de Recherche en Démographie (IFORD), Yaoundé, Cameroon, and the Technical Assistant was based in the Department of Public Health and Epidemiology in the Swiss Tropical Institute (STI), Basel, Switzerland. This unit was responsible for general coordination and correspondence, and also for procurement and supplies.

Three one-week workshops were held for the participating teams during the three years of the study, and were an essential tool for on-the-job training and coordination.

Composition of the teams

The teams were recruited by the local PI and the names proposed to SER. The original plan foresaw the inclusion in each team of one biomedical scientist (physician, biologist, parasitologist or epidemiologist) and one social scientist (sociologist, anthropologist, demographer, etc). This was to allow each country to validate the approach from two different angles: diagnostic performance on the one hand, and acceptability and feasibility on the other.

Consent

All the teams had to obtain ethical clearance through their national or institutional ethical committee. In all seven countries, the informed agreement of the school administrative officers at district level was considered to be sufficient, since both questionnaires and reagent stick testing are non-invasive techniques, and all the children found to be positive were treated. TDR funds were only released to the country teams when the national and local clearances had been obtained.

2.4 Information about acceptability and feasibility

Qualitative observations by the team

The questionnaire approach relies heavily on the involvement of non-health personnel and administrative systems outside the health services. Therefore it was felt to be essential to get a qualitative feedback from all the participants. The investigators were encouraged to make notes throughout the study of all their comments about the operational aspects, and during the second phase actively to seek contact with the people involved (e.g. teachers, politicians, health personnel). In some cases a questionnaire aimed at the teachers was used to get semi-quantitative information on a few key issues like willingness to participate and basic knowledge about schistosomiasis.

Other key informants

Initially, plans were made to ask key informants other than teachers, such as traditional leaders and politicians, to fill in a questionnaire like the one sent to the teachers. These alternative approaches were successful in some countries but not others. Reasons are discussed in Chapter 3 under individual countries.

2.5 Preparation and Distribution of Questionnaires

Two main types of questionnaires were used: one for the schoolchildren (to be filled in by class teachers) and one for head teachers. As these were being used for diagnosis, they were called "diagnostic questionnaires". Examples are given in the Appendix. The children were asked whether they had experienced symptoms from a given list, or suffered from any of a given list of diseases within a specified period. The teachers were asked to rank a number of diseases and symptoms in terms of their importance in their community, and to give their opinion about priorities for community health. The teachers' questionnaire was also sent in some cases to other key informants in the community.

It was an important element in the design of both questionnaires that the fact that the study was primarily aimed at schistosomiasis should be hidden. Nothing on the forms drew attention to schistosomiasis, and questions relevant to schistosomiasis were asked in the context of questions about other diseases and symptoms. As a rule, only people at the level of the district administration were told the full intention of the survey. Others were simply told that it was a general survey of the health of schoolchildren.

In the children's questionnaire, the questions relevant to schistosomiasis were "Did you have blood in your urine?" and "Did you have schistosomiasis?" (and in some countries, "Did you experience pain when urinating?"). In the teachers' questionnaire, "schistosomiasis" and "blood in urine" appeared among a number of other diseases and symptoms present in the area.

Pre-testing of questionnaires

In Zambia and Zimbabwe, the English versions were used. Elsewhere, the teams translated the basic questionnaire into their administrative language: French in Cameroon, Congo and Zaire; Amharic in Ethiopia; Chichewa in Malawi. Pre-testing concentrated on the correct understanding of the items by members of the target groups. For example, the French translation of "blood in urine" was "sang dans l'urine", but this was misunderstood by both teachers and children because it was a term commonly used in the study area to refer to sexually transmitted diseases. The team replaced this item by "urine rouge" ("red urine"). In Zimbabwe, the term "schistosomiasis" was replaced by "bilharzia" and "diarrhoea" by "running stomach". Sometimes, the presentation format also had to be modified. As a result of thorough pre-testing, the questionnaires were found to be well understood in all the countries during the actual study.

Distribution and collection of questionnaires

The questionnaires, together with instructions for the head teacher and the teachers, were sent to all schools in each study area. Distribution and collection were carried out through existing administrative channels. The recipients were asked to fill in the questionnaires as part of a general survey of the health of schoolchildren.

The children's questionnaire: content

Five countries (Ethiopia, Malawi, Zaire, Zambia, Zimbabwe) adopted questionnaires similar to the one used in the original Tanzanian studies (Lengeler et al., 1992). Examples of such questionnaires are given in Appendix 1a (Tanzania) and Appendix 2a (Zaire-in French).

In Ethiopia, the children's ethnic origin, their duration of stay in the study area and their religion were added to the children's questionnaire, in addition to their sex and age. The Ethiopian investigators thought that these factors were important because of the ethnic diversity and migration patterns in the study area.

Two countries, Cameroon and Congo, used a different children's questionnaire, developed jointly by the two countries. This questionnaire used one response-sheet for each child. An example (from Cameroon) is given in Appendix 3. The reason for the modification was that investigators in these countries wanted to include records of treatment (type and site) if a child gave a positive answer for a symptom or a disease. Unfortunately, the operational problems associated with these forms largely outweighed the advantage of having the additional data. The design led to a huge increase in the amount of paper necessary for the study (over 100 kg in the case of Cameroon).

The children's questionnaire: administration

The children's questionnaire was administered to all the children of three classes in each primary school of the study area (target age group: 10-15 years). The class teachers asked the children individually and separately if they had experienced the listed symptoms (e.g. for Malawi: coughing, itching, headache, fever, abdominal pain, blood in stool, diarrhoea) and diseases (for Malawi: malaria, diarrhoea, skin diseases, eye diseases, schistosomiasis, respiratory infections, worms, abdominal problems). The recall period was either two weeks (Cameroon, Congo, Ethiopia, Zambia) or one month (Malawi, Zaire, Zimbabwe).

The teachers wrote down the children's answers as "yes", "no" or "don't know" (counted as "no" in the evaluation). The answers of the whole class (up to 60 children) were written down on a single sheet of paper (front and back).

The teachers' questionnaire

Examples of teachers' questionnaires are given as Appendix 1b (Tanzania) and Appendix 2b (Zaire). Generally, they were completed by the head teacher of each school. The core questionnaire had the following five questions:

- 1 The ranking of the diseases most prevalent among schoolchildren (from a list of diseases).
- 2 The ranking of the symptoms most prevalent among schoolchildren (from a list of symptoms).
- 3 The ranking of priority diseases for control (open - no proposed list).
- 4 The ranking of problems affecting the village (from a list)
- 5 A question about water availability and use.

Explanations were given in a short introduction at the beginning of the form. Generally, six answer lines were provided. There was some variation in detail in the different countries, for example in the order of the questions, language or the space for answers. There was also some variation in the items on the list given for question 1. It was the rank given to "schistosomiasis" or its main symptom "blood in urine" among the various diseases and symptoms prevalent in the area that was of interest, so that it was important for the list of diseases and symptoms to reflect the local disease-pattern. In practice, the patterns were found to be very similar in all the areas studied, so the lists were actually very similar.

2.6 Calculation of positivity rates; ranking of schools

The percentages of positive answers for "blood in urine", "schistosomiasis" (and "pain when urinating" where applicable) were computed by the teams, per class and per school. The results were used to rank the schools.

In the countries where teachers did the biomedical testing, the schools were tentatively classified into low-priority and high-priority groups. This was done by calculating the **median positivity rate** for the question "Did you have schistosomiasis?" Those schools with a positivity rate higher than the median were placed in the "high-priority" group.

2.7 Validation by biomedical testing; determination of prevalence

Biomedical testing was carried out either by the survey teams or by schoolteachers, using reagent-sticks to test for haematuria, and the results used to calculate the prevalence of schistosomiasis.

For each school, two different school prevalence rates were calculated: for a 1+ positivity limit (= all positives) and for a ≥ 2 + positivity limit (only those with 2+ and 3+ results for reagent-stick testing; see below).

Validation by teachers, and cross-checking

In five countries (Cameroon, Congo, Ethiopia, Malawi, Zimbabwe) the testing was done by the schoolteachers, after a seminar in which they were given an introduction to schistosomiasis and were trained in the use of reagent sticks.

In these countries, 30 schools from the low- and 30 from the high-priority group were randomly selected. The teachers then tested up to 120 children in the 10-12 year age-group in each school (all children in the classes in which interviews had been carried out).

To check the reliability of the procedure, the results were cross-checked by the survey teams. Once the results were available, the research team selected randomly 30 schools among the 60 where the teachers had performed the testing. The team visited these schools as soon as possible, and re-tested those of the 120 children previously tested who were present on that day. Care was taken to test the children under exactly the same conditions as the teachers had used, especially at the same time of day, because of the circadian variation of haematuria (Doehring et al., 1985).

Direct validation by the survey team

Two teams, those of Zaire and Zambia, chose a design in which the biomedical team selected 60 schools randomly among the ones that returned the questionnaires. The team then went to these schools and tested 100 children in each with reagent sticks.

In Zambia the main reason for choosing direct validation was the limited availability of the investigators and the long distance between their institution and the field site, so the team preferred a design that would reduce the amount of travel. In Zaire, the reason for choosing

the direct validation design was that a review of the schistosomiasis situation in the study area, based on available health statistics, had revealed that intestinal schistosomiasis was more common than urinary schistosomiasis. It was therefore decided to carry out the Kato-Katz test on stool samples as well as reagent-stick testing for haematuria. It would have been difficult for the teachers to perform the Kato-Katz test, which requires training and experience in laboratory work.

Biomedical testing methods

a. Reagent stick testing Reagent stick testing for haematuria was performed with Sangur sticks (Boehringer Mannheim, Germany). The sticks were used according to the manufacturer's instructions, i.e. briefly dipping the stick into a fresh, stirred urine sample, waiting for about 60 seconds and then reading the colour change by comparison with the colour scale on the container. The results were written down as negative, 1+, 2+ or 3+.

b. Kato-Katz thick smears The evaluation was performed according to the standard method of Katz et al. (1972). Fresh stool was forced through a fine mesh and filled into the hole of a plastic template, calibrated to hold 1/24 g of stool. This amount was deposited on a glass slide and covered with a piece of cellophane soaked in a glycerol-malachite green solution. The smears were allowed to clear overnight and read under a microscope at low magnification. The number of S. mansoni eggs counted was multiplied by 24 to give the eggs per gram of stool.

2.8 Treatment

It would clearly have been unethical not to treat the children found to be positive by reagent stick testing. They were treated with a single, oral dose of Praziquantel (40 mg/kg). Originally, it was planned that at each site the children that were positive would be referred to a health centre and treated there. This proved to be very difficult, and in most situations the teams had to treat the children.

2.9 Data analysis

Data were mainly entered and analyzed in EPIINFO (version 5.01, USD Inc., Stone Mountain, USA). Essential training was given to all the team members during the three study workshops to allow them to perform their own data analysis.

Data analysis included descriptive statistics, Pearson and Spearman correlations, other non-parametric tests for rank analysis, and Bayesian statistics for the calculation of diagnostic performance (Galen & Gambino, 1975).

2.10 Cost analysis

All teams were requested to perform a simple financial cost comparison of four different approaches:

- 1 Questionnaires alone,
- 2 Teacher reagent stick testing alone,
- 3 The two-step approach,
- 4 The estimated cost for a Ministry of Health team to carry out the same screening with a parasitological test.

Since none of the teams had substantial economic expertise, and since suitable specialist support was difficult to obtain, it was agreed that a simple cost comparison should be done, without shadow pricing or discounting.

3. OVERALL OPERATIONAL RESULTS & COUNTRY-BY-COUNTRY DESCRIPTION

In this chapter, a summary of the overall results is given, followed by a country-by country description of the detailed results and observations.

3.1 Introductory remarks

The aim of the multi-country study was to find out whether a method that had been found to be successful in one place would be feasible and acceptable in others. The use of questionnaires to pin-point areas of high risk for schistosomiasis is designed to allow a more efficient use of the resources available for community-based disease control. It relies almost entirely on the participation and work of non-health personnel, mainly primary school teachers. This approach was new for most of the investigators, who were used to being personally involved in carrying out field surveys. In this study, from the moment when the questionnaires were laid on the District Education Officer's desk there was little more the investigator could do.

There were therefore two aims for the study - not only was it necessary to evaluate the diagnostic performance of the questionnaire in a variety of endemic settings, but it was equally important to assess the operational feasibility and the acceptability of the procedure in the different countries. The research guidelines therefore required the investigators to monitor the study process carefully - but without interfering - in order to discover as much as possible about possible reasons for success or failure.

3.2 Overall operational results

A summary of the main operational results is given in Table 1. In all, 67 290 children were interviewed by their teachers, using the children's questionnaire. Simultaneously, 1004 primary school teachers filled in their own questionnaires.

Out of the 686 schools that were targeted, 610 returned the forms - an overall return rate of 88.9%. Return times varied greatly, largely because of external factors. They were fast (2-5 weeks) in five countries. In Malawi, a delay was experienced because of administrative problems and because of extensive floods; these problems also caused Malawi to have a relatively low return rate of 75.2%. In Zambia, the delay was due to a long national strike of civil servants, just before the then President H.E.K. Kaunda agreed to hold open elections. Strikes also affected the Cameroon, Congo and Zaire teams but they managed to time the work so as to avoid problems. In Ethiopia, the team had to work during quiet periods at a time of major military confrontations in the country.

Table 1: Summary of main operational results

	Cameroon	Congo	Ethiopia	Malawi	Zaire	Zambia	Zimbabwe	Total
QUESTIONNAIRES								
# Schools	106/113	58/58	28/28	85/113	136/160	87/93	110/121	610/686
Return rate (%)	93.8	100.0	100.0	75.2	85.0	93.5	90.9	88.9
Return time ¹	4 weeks	2 weeks	4 weeks	16 weeks	4 weeks	20 weeks	5 weeks	
# Children	8,281	5,590	2,918	7,201	19,362	7,875	16,063	67,290
# Teachers ²	502*	58	28	83	136	87	110	1,004
Mean age ± s ³	11.3±1.6	12.5±1.7	11.9±2.4	13.2±2.0	12.5±1.8	11.8±1.7	9.0±2.2	
Sex-ratio m:f	3.1:1	1.2:1	1.2:1	1.5:1	1.3:1	1.3:1	1.3:1	
BIOMEDICAL TESTING								
Technique ⁴	TRST	TRST	TRST	TRST	K-K	RST	TRST	
# Schools	60/60	53/58	24/24	54/58	60	57	49/60	407
Return rate (%)	100.0	91.4	100.0	93.1	NA	NA	81.7	92.3
Return time ¹	3 weeks	4 weeks	2 weeks	4 weeks	NA	NA	3 weeks	
# Children	6151	5842	2662	4841	6124	2495	5647	38,595
Mean ages	11.5±1.8	12.4±1.8	12.0±2.5	13.0±2.0	13.3±1.9	12.5±1.6	9.0±2.8	
Sex-ratio m:f	3.2:1	1.3:1	1.6:1	1.5:1	1.3:1	1.5:1	1.5:1	

¹ Total time for the return of the percentage of questionnaires in the line above.
² In Cameroon the team interviewed all teachers in each school instead of only the head teacher.
³ s = standard deviation
⁴ RST=Reagent Stick Testing, TRST=Teacher Reagent Stick Testing, K-K=Kato-Katz thick smear.
NA=Not Applicable.

In the validation stage, 32 471 children were tested with reagent sticks (25 143 by teachers, 7328 by the teams). A further 6124 children in Zaire were tested with Kato-Katz stool examinations (2495 of those had both tests done). Where testing was carried out by teachers, they completed the tests within the short period of 2-4 weeks, and with a high return rate (overall 92.3%). The mean ages and male/female sex-ratio are given in Table 1. As can be seen, they were similar in the questionnaire phase and the biomedical testing phase. This was an important prerequisite for the comparability of the data.

3.3 Cross-checking of reagent stick testing done by teachers

Cross-checking was carried out in the 5 countries in which the teachers had performed the reagent stick testing (Cameroon, Congo, Ethiopia, Malawi, Zimbabwe). Overall, the results of the cross-checking were good. In all the countries except Ethiopia, where problems arose (probably because the level of haematuria was low) the teachers seemed to have done the testing well. The teachers' results could therefore be used for the validation of the questionnaires. Table 2 gives a summary of the main results.

Cross-checking results were only analysed at the school level, and not at individual level, because of the day-to-day variability of haematuria. In all five sites the rate of school misclassification was also determined - that is, the number of low-risk schools defined as high-risk on the basis of the teachers' testing results, or vice-versa - and a Mc-Nemar Chi-Square test for matched pairs was calculated.

Table 2: Main results from cross-checking of teachers' results for reagent-stick testing.

	Cameroon	Congo	Ethiopia	Malawi	Zimbabwe
# Schools	31	31	24	51	44
# Children	2394	3515	2602	3420	4098
Correlation $\geq 1+$	$r=0.86$ $p<0.001$	$r=0.97$ $p<0.001$	$r=0.15$ NS	$r=0.77$ $p<0.001$	$r=0.68$ $p<0.001$
Correlation $\geq 2+$	$r=0.85$ $p<0.001$	--	$r=0.61$ $p<0.01$	$r=0.76$ $p<0.001$	$r=0.82$ $p<0.001$
# Schools Misclassified (high-risk limit ¹)	4/31	1/31	6/24	11/51	11/44
χ^2 Mc Nemar	0.75, NS	0, NS	0.26, NS	0, NS	1.5, NS

¹ For definition of high-risk limits see Table 11

NS=Not Significant

3.4 Detailed Country-by-Country Reports

3.4.1 Cameroon

Study area

The study took place in the Mayo Danay District, in the Far-North province. The area of the district is 5260 km², and the main town is Yagoua. The area is part of the Sahelian belt, with a hot and dry climate and a short rainy season. One large river (the Logone), one artificial lake (Maga) and irrigated rice fields are the main water bodies. A total of 310,000 people live in this rural district, and the main economic activity is the production of cotton, rice and groundnuts, and cattle-breeding. Millet and sorghum are the staple foods.

During the period of the fieldwork numerous general strikes ("villes mortes" : "ghost towns") in support of multi-party elections affected the country.

Questionnaire distribution

Questionnaires were not given to the "inspecteur départemental" (District Education Officer) as originally planned, but to the "sous-inspecteurs" in each of the four "arrondissements", one level below. The "sous-inspecteurs" distributed the forms to all the schools and were also responsible for the re-collection. The team assisted the distribution work of the "sous-inspecteurs" with money for petrol and per diems.

Completion and return of questionnaires

From the 113 target schools, the team got back 106 completed questionnaires (93.8 %) within one month. A total of 8281 children of classes CE2 and CM1 were interviewed (average 78 per school). The mean age of the children was 11.3 years. The sex ratio was 3:1 and reflects the very different school-attendance rates of boys and girls in this Islamic society. Although the sex-ratio was above unity in all the seven countries, nowhere was the difference as extreme as in Cameroon.

The children's questionnaire had one sheet per child. Usually the teacher filled in all the forms by asking the children the questions one after another. Sometimes the children filled in the forms, following their teacher who read the questions out to the whole class. Consequently, the time needed to complete this task varied between half an hour and four hours. The large amount of paper necessary for the Cameroonian children's questionnaire (see Section 2.5) seems not to have affected the operational feasibility.

The Cameroonian team decided to ask all the teachers, not only the head teachers, to fill in the teachers' questionnaire. They then took the median of the answers in each school. The answers of 502 teachers (from 99 schools) were obtained, a mean of 5.1 respondents per school.

Biomedical testing

Four teacher training seminars were organized, one in each of the 4 "arrondissements".

The teachers tested 6151 children in 60 schools within 3 weeks with reagent sticks (average: 103 per school). The forms were returned to the school administration along the normal administrative channels.

Qualitative information: opinions of teachers

Almost all the teachers (57/59) saw the filling-in of the questionnaires and the reagent stick testing as part of their duty to the children. Many thought that since they felt close to their children, they could do this work well. There was a general feeling that this work had helped them to understand the health of the children better. Almost all the teachers reported that the instructions on the questionnaire were sufficient to carry out the work correctly, but that some words were not always understood by all the children.

About 44% of the teachers reported some problems during the stick testing (children's refusals, discipline, problems in reading the results) and 56% reported no problems at all. Among the reported problems, only 9% (reading, smell of urine) were such that they could perhaps have been handled better by health professionals.

General knowledge about schistosomiasis

"Bilharzia" is a well-known disease among the local population and has specific names in each of the local languages (Peul, Toupouri, Mouseye, Mousgoun). The team found that there were usually two different names: one for schistosomiasis and one referring to "blood in urine" or "red urine". In the Peul language, schistosomiasis was called "Tchile Nange" ("the disease of the hot sun") - perhaps because during the hot period people tend to be dehydrated and their concentrated urine may show signs of macrohaematuria more readily. An interesting observation was that some knowledge of the disease arose from previous work done by biomedical scientists in the area.

Among the teachers, 72% (out of 64) knew about the disease. Almost 86% of them cited blood in urine as a symptom, 41% cited pain when urinating, and 9% weight loss and diffuse lower abdominal pain. About half believed that schistosomiasis was transmitted by contact with infected water and about 30% thought that the disease was transmitted by drinking contaminated water. As control measure 63% cited not swimming in standing water, 48% not drinking pond water, 25% using latrines, 20% going to hospital for treatment, 16% destroying aquatic snails and 10% general hygiene.

Other informants

In Cameroon, the idea of using traditional leaders as key informants was dropped because they could not be reached by any administrative channel. They are mostly religious and feudal leaders, who can only be approached in a very formal way. In addition, it was felt that they were unlikely to be well informed about children's diseases.

Local difficulties

In Cameroon the study coincided with a new EPI campaign for the immunization of young women against tetanus (in order to prevent neonatal tetanus in their offspring). This campaign had been insufficiently explained to the people, and there was soon a popular belief that it had been launched to sterilize girls. Because people tended to confuse the present study with the EPI campaign, it was necessary to have extensive discussions with the parents of the children, and to obtain their formal consent. The biomedical testing was finally completed after discussions with the teachers and the parents, and after an intervention by the education authorities.

Cross-checking

Cross-checking was performed on 2394 children in 31 schools (average: 77 per school). A very good correlation between the teachers' and the team's testing was noted ($r=0.86$, $p<0.001$).

For determining high-risk schools there were 4/31 misclassifications ($p<0.5$, difference not significant).

3.4.2 Congo

Study area

The Bouenza Region, in southwest Congo, is a forest area. The study area consisted of 6 largely urbanized districts around the town of N'Kayi, with a total area of 17,000 km² and a population of 150,000. The climate is tropical with a mean temperature of 25°C. The main occupations in the area are agriculture, fishing and work in a sugar factory. There is also a large number of civil servants.

The transition to a multi-party political system took place during the time of the study, and numerous strikes of civil servants - including the schoolteachers - affected the timing of the work.

Questionnaire distribution

Out of the 162 schools of the Bouenza region, only 58 had 100 or more children in the relevant classes (classes 4, 5 and 6) and were therefore considered eligible for the study. The distribution of the questionnaires to these schools was done by giving a project car with a driver to the central school inspector. He then went to each of the six local school directorates, took another car from the education department there, and visited all the schools personally. The re-collection was done in the same way, two weeks later. The reason for this direct support for questionnaire distribution was the very difficult social situation in Congo at the time, with political turmoil resulting in numerous strikes and disorganization.

Completion and return of questionnaires

All 58 schools gave the completed questionnaires back to the inspector after 2 weeks. A total of 5590 children were interviewed by their teachers (average: 96 per school) and all 58 head teachers answered.

Biomedical testing

The teachers tested 5842 children in 53 schools within 4 weeks with reagent sticks (average: 110 per school). Both the teacher testing and the cross-checking were performed on the same day in 31 schools. The team collected the testing forms from these schools, and the others were sent back through various channels (administrative, postal and with travellers).

Qualitative information: opinions of teachers

Teachers and local leaders were equally keen to participate in the study and they wished to extend it to all children in their community. The teachers considered the work to be part of their duties. They were already concerned about improving the health and academic performance of the children, and had often already learned something about health care by themselves, in order to help the children. They reported that some parents consulted them on health matters and that they felt that they were better able to do a community diagnosis than the health personnel because the children trusted them. The teachers did not report any problems with handling urine or stool samples.

General knowledge about schistosomiasis

More than half of the teachers cited "red urine" as the way to diagnose the disease and they also recognized this symptom in adults.

Other informants

Questionnaires aimed at village leaders were also handed over to the head teachers of the schools, who were responsible for passing them on. 29 village leaders out of 58 (50%) filled in a questionnaire. This rather low number was largely due to the fact that in these times of troubles and emerging multi-party politics it was not always an easy task for teachers to hand on the forms. Interestingly, one result of the political activity going on at the time was that in certain areas the politicians of different parties actually asked to participate in the study, because they wanted to be seen doing something for the common good. The interest of the teachers contrasted with the apparent inactivity of the village health committees. However, there was no apparent conflict with the health personnel, and many reported that they had previously referred children for treatment.

Cross-checking

The cross-checking was performed on 3515 children in 31 schools (average: 113 per school). The procedure was a little different from that adopted by the other countries; the team followed a timetable agreed with the teachers, and cross-checked the teachers' testing on the same sample on the same day. Care was taken that the teachers performed the testing on their own, in a separate room. A very good correlation between the teachers' and the team's testing was noted ($r=0.97$, $p<0.001$).

In determining high-risk schools there were 1/31 misclassifications ($p=1$, difference not significant).

3.4.3 Ethiopia

Study area

The study area was the Middle and Lower Awash Valley in the east of Ethiopia, with an area of approximately 40,000 km². This generally dry area is dominated by the Awash River, which flows down from the central highlands. Earlier, the valley was inhabited almost exclusively by semi-nomadic pastoralists. However, since large-scale irrigated agricultural development (mainly cotton-growing) began in the early 1960s, there has been an influx of labourers from other parts of the country. At the moment, the total population of the Awash Valley is estimated at 250,000. About 20,000 indigenous pastoralists still remain in the vicinity of the agricultural schemes, often using the irrigation systems for their domestic needs. Their schistosomiasis infection rate is usually higher than that of the migrant labourers (Kloos et al., 1977).

During the time of the study new political forces ousted the government of President Mengistu, and this led to major difficulties with the field work.

Questionnaire distribution

Questionnaires were distributed by the District Education Officer (DEO) or the District Administrative Office (DAO) to all 28 primary schools of the Lower and Middle Awash valley, and were returned within 4 weeks.

Completion and return of questionnaires

A total of 2918 children were interviewed (average: 104 per school). The majority of the children (60%) were members of the Amhara ethnic group, whose members migrated into the area during the last decades. About half were Christian and half were Muslim.

Some problems with the completion of the questionnaire were mentioned. A recall period of 15 days was felt to be too long, and it was suggested that one week would be better. Some children seem to have concentrated on some questions with the hope of getting treatment. Finally, it was reported that many girls were shy about answering.

Biomedical testing

Teacher training seminars were organized in three localities, two in Middle Awash (Melkawerer and Gewane) and one in Lower Awash (Assaita).

The teachers tested 2662 children in 24 schools within 4 weeks with reagent sticks (average: 111 per school). The teachers executed the testing almost immediately, and the forms were collected by the team when they came for the cross-checking (in which all the schools were included). Four of the schools that had participated in the questionnaire phase had to be left out of this phase because of the military situation.

Providing a urine specimen was not a problem for the children, nor was the handling of urine a problem for the teachers.

Qualitative information: opinions of teachers

In general teachers had a favourable opinion of the questionnaire and the testing, and the school administration was supportive. However, the selection of only a few teachers for the testing was felt among other teachers to be favouritism because there was an underlying feeling that clear benefits were associated with the testing. Most teachers who were involved actually suggested that these activities should be more "remunerative".

General knowledge about schistosomiasis

Only a small minority of the teachers and community members knew about bilharzia, as the disease is called in Ethiopia. Those who knew the disease seemed to define it as a kind of internal disease but failed to describe it in any way. Only a few children seemed to know bilharzia and it was not considered to be a major health problem. As a consequence, the response "I don't know" was frequent in the children's questionnaire. Interestingly, the indigenous Afar pastoralists have a name for schistosomiasis ("Dahogera") which means literally "blood in urine". But few Afar children attend school, for religious and cultural reasons, and only a few of them were included in the present study.

These facts might explain the inability of the diagnostic questionnaire to describe accurately the situation in Ethiopia. The prevalence of the disease is very low in the immigrant population from the highlands, to which the majority of the schoolchildren belong, and (maybe as a consequence) the people do not recognize the disease well.

Other informants

In Ethiopia, the initial idea of using the peasants' associations was dropped because these organizations, being of political rather than professional origin, were no longer functioning in the unsettled political and military situation.

Local difficulties

Additional reported problems included the fact that many students were suspicious of the interview because they associated it with military recruitment which was going on during that time.

Cross-checking

The cross-checking was performed on 2602 children in 24 schools (average: 108 per school). At the 1+ positivity level the correlation between the teachers' and the team's testing was poor ($r=0.15$, $p>0.1$). Correlation was much better at the 2+ positivity limit ($r=0.61$, $p<0.01$).

The teachers' results largely overestimated the prevalence rates. The main problem was with negative readings vs. 1+ cut-off. For determining high-risk schools at the >2+ positivity limit there were 6/24 misclassifications ($p>0.5$, no significant difference).

3.4.4. Malawi

Study area

The study area was Mangochi District in the Southern Region of Malawi (southern end of Lake Malawi). The district has a surface of 6272 km² and a total population of 496,000, who are predominantly Muslim. The areas along the lake and the Shire River are the most densely populated. The settled areas are mostly low-lying, with various types of fresh water bodies such as swamps, rivers and ponds. Numerous fishing communities are found along the lake and the Shire River. The area experiences high temperatures throughout the year (25-30°C), with a rainy season (Nov.-April) and a dry season (May-Oct.). Mangochi district has six Traditional Authorities (T/A) or chiefs. A T/A may have a hundred villages or more, which are led by a village headman. During the time of the study catastrophic rains led to major floods and landslides, rendering communication between Lilongwe, the capital, and the study area very difficult.

Questionnaire distribution

The original plan was that the questionnaires would be distributed to the 113 target schools by the District Education Office staff, in the car that brought the salaries at the end of the month. The head teachers were to send the completed forms back by ordinary mail. Five weeks later only 47 questionnaires (41.6 %) were back in the hands of the investigators. This was partly due to a breakdown of the postal system due to catastrophic heavy rains. However, when the team followed up the matter at the District Education Office, they found blank forms still in the office, which indicated that not all the forms had even been distributed.

Completion and return of questionnaires

Eventually, after 16 weeks the questionnaires from 85 schools (75.2%) were back, and 7201 children had been interviewed (average: 85 per school). 83 teachers had filled in their questionnaire (73.5%).

Biomedical testing

The teachers tested 4841 children in 54 schools with reagent sticks within 4 weeks (average: 90 per school).

Qualitative information

Most teachers were eager to participate in the study, and those who received the forms filled them in properly and sent them back fast. Most teachers reported that schistosomiasis was a major problem among the pupils in Mangochi. The unsatisfactory operational result was due partly to unavoidable problems with the post, and partly to the fact that the DEO failed to organize the distribution of the forms properly.

The treatment part of the study pleased most teachers because they felt it was useful for the health of their pupils. Some asked for more reagent sticks to test the remaining pupils in their schools. In a few schools teachers put forward special requests for testing one or two pupils

who were known cases of schistosomiasis and all these special requests turned out to be positive. A few teachers thought they had schistosomiasis themselves and asked to be tested and treated. This was also done. However, their request to test members of their family was discouraged as there were not enough reagent sticks.

Other informants

In Malawi, the initial idea of using traditional leaders was abandoned because of their high illiteracy rate and because the teachers suggested that they would not be familiar with children's diseases. Unfortunately this was not followed up and could therefore not be confirmed. The idea of addressing religious leaders was also dropped because there was no practical way of reaching them.

Local difficulties

In some schools, a few pupils ran away during cross-checking because they thought the team would take their blood.

Cross-checking

The cross-checking was performed on 3420 children in 51 schools (average: 68 per school). At both the 1+ and 2+ positivity levels the correlation between the teachers' and the team's testing was good ($r=0.77$, $p>0.001$ and $r=0.76$, $p<0.001$).

There were 11/51 misclassifications of high risk schools, evenly distributed between over- and under-estimation ($p>0.5$, no significant difference).

3.4.5. Zaire

Study area

The study area was the town of Matadi and the administrative Zone of Songololo, in the narrow stretch of land between the Zaire River and the Angolan Republic, west of Kinshasa. The total population in this area of 9000 km² was 380,000. of whom about 47% were Matadi. About 26% of the people were non-Zaireans, mainly Angolan refugees. The main crops, grown on a subsistence basis, are cassava, beans, groundnuts and maize. There is a little industry in Matadi. The hydrography is dominated by rivers flowing south-north, from Angola into the lower-lying Songololo area. The rainy season lasts from October to May.

Major civil troubles affected the timing of the study, which was only completed in September 1992, one year later than the others.

Questionnaire distribution

The questionnaires were deposited at the two "inspections du pool" of the Songololo Zone. From there, they were distributed by the school system to all mobile inspectors ("inspecteurs itinérants"). These inspectors are responsible for a few dozen schools, and visit them regularly to pay salaries. Unfortunately, the re-collection of the questionnaires could only partially be done in the same way, mainly because of a national strike. The team therefore had to assist the inspectors with transport and per diems, in order to recover the forms in a reasonable time. Further difficulties were caused by the difficulty of access to certain areas, and the fact that a few key administrative personnel were moved during the study period.

Completion and return of questionnaires

Of the 160 target schools, 136 (85.0 %) completed the questionnaires within one month. A total of 19,362 children (average: 142 per school) were interviewed by their teachers.

Biomedical testing

Testing was carried out by the team. A two-stage stratified random sample of 60 schools was drawn from the 136 who had returned the questionnaires. The unit of stratification were the "collectivités", the administrative level below the "zone". In order to save trips only half the necessary schools were drawn at random, and the nearest school was then added to the sample. The team tested 6124 children with Kato-Katz thick smears within 3 weeks (average: 102 per school).

Since the first batch of reagent sticks had been stolen (at Kinshasa airport) the urine testing could not be done at the same time and was only completed one year later. Only 41 % of the children tested in 1991 could be found again and 2495 children in 49 schools were tested (average: 51 per school). A substantial number of Angolan children had returned home during the summer of 1992 because of the phase of national reconciliation in Angola and the forthcoming elections. This second testing also allowed the team to treat the positive children.

Qualitative information: opinions of teachers

In general, the education authorities were very supportive. Unfortunately, the teachers and head teachers were much less cooperative. They considered that it was not part of their duties to deal with health, and that they should therefore be paid specially for these activities. It should, however, be mentioned that the overall situation in Zaire was very difficult at that time and that civil servants were no longer being paid. The teachers tended to assume that any study of this type was being supported from outside, and therefore to see it as a potential source of money.

General knowledge about schistosomiasis

Schistosomiasis is widespread and frequent in this area and people were well aware of it. Knowledge about the disease varied according to age and education. Older people, especially, considered that the disease was due to witchcraft. The basis for this belief was the observation that everybody was in contact with water but only certain people got sick. How could this difference be explained, except by witchcraft? Even when people knew that you got the disease from contact with infected water, they said that it was necessary to use the water, so transmission prevention would be virtually impossible. A few community respondents mentioned water snails as the source of the disease. Modern treatment was cited as the best choice by most people, especially the younger ones, but it was often difficult to get hold of.

Other informants

The questionnaires aimed at the village leaders were distributed through the civil administration. A small transport allowance was paid to all the persons involved in the distribution of the forms. Many of the leaders were illiterate, so that their secretaries assisted them with filling in the forms. It seems that the chiefs also frequently requested mothers to assist them, in order to get information about the health of the children. Out of 530 village leaders, 510 (96.2%) answered their questionnaire within one month. The results will be reported in detail later.

Local difficulties

The team encountered major problems with traditional beliefs while doing the bio-medical validation. Numerous rumours went round in the area that the team was taking specimens from the children for witchcraft purposes. A few times all the children ran away from the school as soon as the team approached. Once, this episode could be related to one individual spreading a rumour and its subsequent rapid amplification. In other cases, the parents offered to give stool samples instead of their children in order to prevent them from being bewitched.

This team also encountered the problem of confusion with vaccination campaigns experienced by the Cameroon team, because they had borrowed a car from the EPI programme to tour the schools. Another factor which rendered their work more difficult was a former trypanosomiasis screening programme, which had taken blood samples one year before in two zones and had never fulfilled the promises for treatment made at that time. People were afraid



the same would happen again. The situation was especially difficult because this was a border area in which a lot of Angolan refugees had settled. The majority of them were illiterate and still very attached to their traditional beliefs. This meant that a lot of time and effort was needed to inform the community about the study and obtain their consent.

3.4.6. Zambia

Study area

The study area was Isoka District, in the Northern province of Zambia. The district is more than 1000m above sea level, and shares borders with Tanzania in the north and Malawi in the southeast. Isoka District has a surface of 14,000 km² and an estimated population of 100,000 living in the two towns of Isoka and Nakonde and in approximately 600 villages in the valleys and plains of the Lwangwa river. The vegetation is mainly savannah grass lands with open forest. The area has an average rainfall of over 500mm during the rainy season, which lasts from November to March. The people living in this district are predominantly subsistence farmers.

A long strike of civil servants, just before the transition to a multi-party system, affected the first phase of the study.

Questionnaire distribution

The questionnaires were distributed by the District Education Officer, during one of his routine trips to all the schools of the district. The team assisted the DEO with a vehicle for this trip because his own vehicle had broken down. Unfortunately, the forms were distributed at the very end of the school year and the teachers were later involved heavily in work on a national census. Then a nation-wide strike stopped all school activities for some time. For this reason the re-collection proceeded very slowly, and after 5 months the team decided to assist the DEO with a vehicle again in order to recover the forms.

Completion and return of questionnaires

Out of the 93 target schools, 87 (93.5 %) returned the forms after 5 months. A total of 7875 children were interviewed by their teachers (average: 90 per school).

Biomedical Testing

A simple random sample of 60 schools was selected for reagent stick testing by the team. Two data sheets were lost later and therefore the results from only 58 schools are available. The team tested 4833 children (average: 83 per school).

Qualitative information: opinions of teachers

Out of 70 teachers, 93% stated that it was their duty to fill in the questionnaires. There was a strong opinion that there was no conflict with the health personnel (91%) and many teachers (49%) had already referred children for schistosomiasis treatment.

All teachers except one agreed that in theory they would have been willing to do some biomedical testing. However, over 40% of them said that they should receive extra payment for this. Over 96% of the teachers stated that handling urine would be acceptable to them, and 74% thought the same for stool specimens.

General knowledge about schistosomiasis

Regarding main symptoms, 97% of the teachers mentioned blood in urine while only 3% mentioned pain when urinating. A total of 76% of the respondents found that the school performance of the children was affected by schistosomiasis. On average, the teachers had been in the area for 6 years.

A few surveys have been carried out in recent years in the area by teams from the Tropical Diseases Research Centre of Ndola. The schools involved were excluded from the present study because it was feared that this could have influenced people's perception of the disease and its importance. There is also intestinal schistosomiasis in this area but no information was available on this.

3.4.7. Zimbabwe

Study area

The study area was Makonde District, 120 km north-west of Harare. The total population is 123,000, mainly belonging to the Shona culture and language group. The area is divided into communal areas (peasant farming households), areas of small-scale farming and an area of large-scale farming (tobacco, cotton, wheat, soya beans and maize). There are 17 small streams and 25 dams, but no larger rivers. The seasons are well defined, with a hot dry season from September to November, a hot wet season from December to March, a cold wet season from March to May and a cold dry season from June to August. The provincial centre is Chinhoyi and there is an economic growth point in the area. Sanitation is often poor, particularly in the large-scale farming areas. An active water and sanitation programme is underway in the communal area of the district, and it is anticipated that by 1995 each household in that area will have a latrine and easy access to clean water.

Questionnaire distribution

The questionnaires were left with the District Education Office (DEO) for distribution to the 121 primary school head teachers via four Education Officers. The head teachers usually come to see the EO once per month for the pay sheet, and this was an easy way of reaching them.

Completion and return of questionnaires

A total of 110 questionnaires (90.9%) were returned to the team within five weeks and 16,063 children were interviewed by their teachers (average: 146 per school).

Biomedical testing

A single but very well organized teacher training seminar was held at the district capital Chinhoyi. During the training seminars many questions were addressed to the team members by the teachers regarding schistosomiasis, its transmission and its control.

The teachers tested 5647 children in 49 schools with reagent sticks (average: 90 per school). The result forms were mainly re-collected directly by the teams, during the cross-checking phase.

Qualitative information: opinions of teachers

All the 49 teachers that the team interviewed had found the questionnaire and reagent stick testing useful and 73% thought that schistosomiasis was a serious problem. The teachers emphasized the educational role of the activities, and the hope that they could contribute to changing traditional beliefs regarding this disease - for instance, that it can be transmitted by eating too much salt, jumping across the fire, or using toilets while wearing shoes. However, there were problems, ranging from inadequate equipment to the attitude of teachers. The teachers mentioned that the provision of an "incentive" might help to motivate them.

Other informants

The district health personnel answered a questionnaire similar to that of the teachers. Unfortunately the data have not yet been properly analysed.

Local difficulties

Religious beliefs gave rise to some problems; some parents belonging to the Apostolic Faith Church refused to let their children participate in the urine testing. Some other parents did not trust the ability of the teacher to perform the testing.

Cross-checking

The cross-checking was performed on 4098 children in 44 schools (average: 93 per school). At both the 1+ and 2+ positivity limits the correlation between the teachers' and the team's testing was good ($r=0.68$, $p>0.001$ and $r=0.82$, $p<0.001$).

In eight schools the prevalence was overestimated and in three schools it was underestimated. No significant difference ($p>0.1$) was found between the teachers' and the team's testing regarding the classification of schools into low-risk and high-risk categories.

4. VALIDATION: ASSESSMENT OF DIAGNOSTIC PERFORMANCE

4.1 Introduction

The idea behind the use of questionnaires is to carry out "community diagnosis" - to identify areas where treatment for schistosomiasis is likely to be a priority. For this purpose, it is necessary to ensure that the level of infection as deduced from the questionnaires is a reasonably good predictor of the real prevalence as assessed by biomedical tests.

For the purpose of community diagnosis, the negative predictive value of a test is of great importance. No test can be expected to be 100% reliable in predicting either the proportion of people who have the disease (positive predictive value) or the proportion who do not have it (negative predictive value). A high negative predictive value will mean that communities diagnosed as negative really can safely be excluded from treatment schemes. The use of such a test may result in the inclusion of a few borderline communities in a treatment scheme, but the small waste of resources that will result is less dangerous than eliminating communities where people are really in need of treatment.

4.2 Summary of procedure

- 1 **Calculation of questionnaire positivity rates**, that is, the percentage of positive answers for the schistosomiasis-related questions, for both schools and countries: "School positivity rates" and "country positivity rates". "Don't know" was recorded as "no".
- 2 **Calculation of the prevalence** of schistosomiasis, as measured by biomedical testing, for schools and countries.
- 3 **Examination of the correlation** between the percentage of positive answers to each of the relevant questions in the questionnaires and the measured haematuria prevalence.
- 4 **Identification of the "best" question** in each country. The best question was defined as that giving the highest correlation.
- 5 **Assessment of the diagnostic performance** of the questionnaires, using the results for the "best" questions.

This procedure was used for both the children's and the teachers' questionnaires.

4.3 The children's questionnaire

4.3.1 Questionnaire results; positivity rates

The percentage of positive answers (positivity rate) for each of the "schistosomiasis-related" questions: "Did you have blood in your urine?", "Did you have schistosomiasis?" and (in some countries) "Did you have pain when urinating?" is shown in Table 3. A wide range was found in the percentage of positive answers between the countries (3.6 - 38.7% for "schistosomiasis", 4.1 - 34.9% for "blood in urine").

Within countries, there was usually a good agreement between the positive answers for "schistosomiasis" and for "blood in urine". The exceptions were Ethiopia and Zaire. In Ethiopia more children reported "blood". The reason may have been that the disease "schistosomiasis" was not well known in the community there, so many children answered "no" or "don't know" (Section 3.4.3). In Zaire, positive answers to the question "did you have schistosomiasis" are almost twice as frequent. This can be accounted for by the fact that there is a high prevalence of *S. mansoni* infection, which is also known as "schistosomiasis" but does not cause haematuria. The question on "pain when urinating" correlated with the other two in three of the four countries where it was asked; in Ethiopia this was not the case, but the reason is not clear.

The relationship between the answers "blood in urine" and "schistosomiasis" for all 609 schools is shown in Fig.3. The coefficient of correlation is 0.87. Many of the schools in Zaire, which are marked as circles in the figure, clearly lie well away from the regression line. This type of pattern might be a quick method of identifying areas of mixed infection. If Zaire is not included in the calculation, the regression line becomes steeper, and the correlation increases to 0.92.

4.3.2 Biomedical testing; results of urine and stool examinations

The main results for urine and stool testing are shown in Table 4. Since the reagent stick testing done by the teachers had been found to be reliable (Section 3.3), these figures were used for the calculations. The overall country prevalence of haematuria at the $\geq 1+$ level ranged from 18.3% in Congo to 63.6% in Cameroon. This variation was expected, because the multi-country study had been designed to include a number of very different transmission situations.

The mean level of haematuria intensity varied among children with a positive result for the test. The range was from 1.42 (Ethiopia) to 2.41 (Cameroon). Except for Ethiopia, which had a high prevalence of haematuria but a low intensity, countries with a higher prevalence of haematuria also had a higher mean level of intensity. (Fig.4)

In Zaire, both Kato-Katz thick smears and reagent stick testing were performed by the team. The overall *S. mansoni* prevalence was 31.0%, while *S. haematobium* was found in 20.0% of the tested children. Mixed infections occurred in only 204/2495 (8.2%) of the children who had both tests, a low proportion that might indicate that transmission of the two diseases occurs in separate places. This was confirmed by the fact that there was no correlation between the prevalences of the two species at school level ($r=0.19$, $n=50$, not significant).

Table 3: Main children's questionnaire results. The results indicate the percentage of children reporting the relevant disease/symptoms.

	Cameroon n=106	Congo n=58	Ethiopia n=28	Malawi n=85	Zaire n=136	Zambia n=87	Zimbabwe n=110
Recall period (days)	15	15	15	30	30	15	30
"Blood in urine" Reporting/total %	2541/8281 30.7	353/5590 6.3	121/2918 4.1	2513/7201 34.9	1646/19362 8.5	1965/7875 25.0	3439/16063 21.4
"Schistosomiasis" Reporting/total %	2719/8281 32.8	338/5590 6.0	104/2918 3.6	2786/7201 38.7	3162/19362 16.3	2084/7875 26.5	3980/16063 24.8
"Pain when urinating" Reporting/total %	2716/8281 32.8	540/5590 9.7	327/2918 11.2	--	2443/19362 12.6	--	--
Correlation coefficient "schisto"/"blood"	0.84	0.91	0.12	0.90	0.64	0.94	0.88
p value	p<0.0001	p<0.0001	NS	p<0.0001	p<0.0001	p<0.0001	p<0.0001

NS = not significant

Figure 3

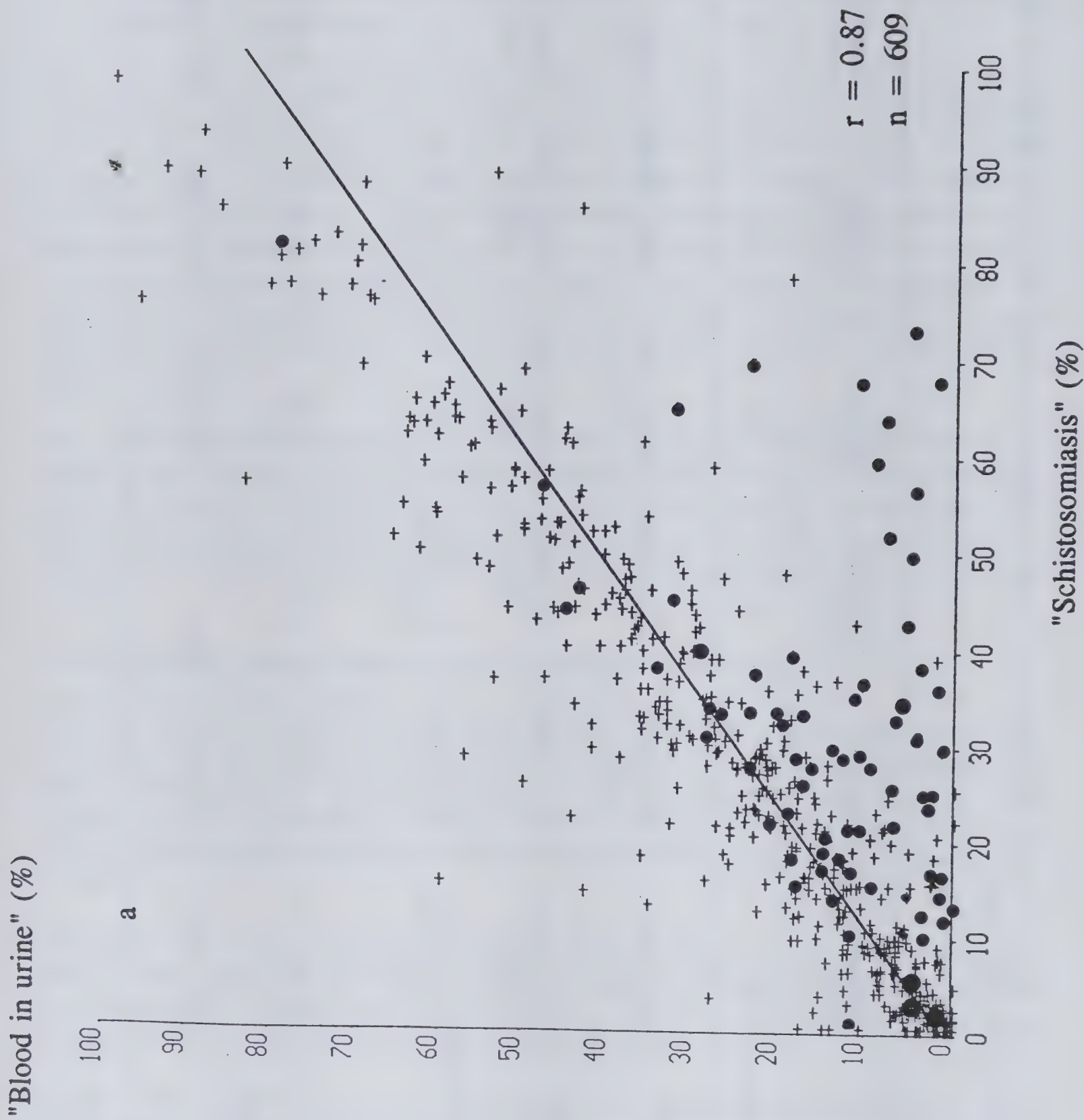
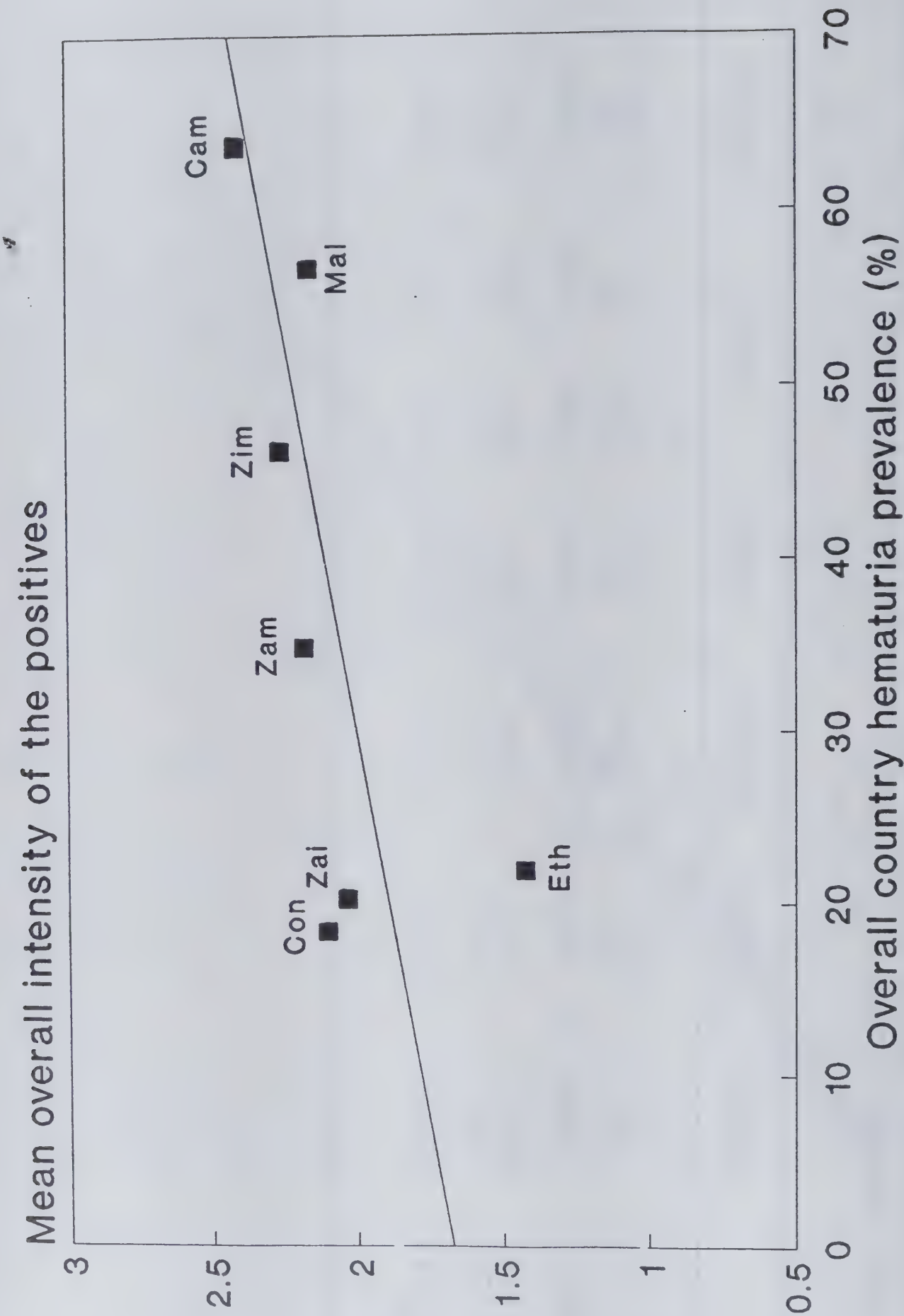


Table 4: Urine and stool testing results. Results of reagent stick testing (RST) and in Zaire also Kato-Katz (KK) thick smears.

	Cameroon	Congo	Ethiopia	Malawi	Zaire	Zambia	Zimbabwe
<u>Validation</u>							
Technique	RST	RST	RST	RST	RST	RST	RST
No. schools	60	53	24	54	57	58	49
No. children	6151	5842	2662	4841	2495	4834	5647
Prevalence $\geq 1+$	63.6	18.3	21.9	56.6	20.2	34.8	46.1
Prevalence $\geq 2+$	52.4	12.8	6.9	40.9	13.4	22.3	34.1
Mean intensity of positives	2.41	2.10	1.42	2.16	2.03	2.18	2.26

Figure 4



4.3.3 Correlations between positivity rates and biomedical testing

Overview of the results

Investigating the correlation between the questionnaire answers and the results of the biomedical tests was one of the central issues in the present study, and it was the first step in assessing the diagnostic performance of the questionnaires. In most countries "schistosomiasis" and "blood in urine" gave similar coefficients of correlation when compared to the biomedical testing. The results for the question giving the best correlation for each country between the reagent stick testing and the percentage of positive answers are shown in Table 5.

The questionnaire responses (percentage of positive answers to the "best question") correlated well with the school haematuria prevalences, except in Ethiopia. In this country the questionnaire approach did not describe the schistosomiasis situation accurately; possible reasons for this failure are discussed in Sections 3.4.3 and 5.1. Correlation coefficients were high and very significant in all the remaining countries, ranging from $r=0.37$ in Zambia to $r=0.83$ in Congo.

In Zaire, where both intestinal and urinary schistosomiasis are prevalent, "schistosomiasis" correlated much better with the results of the Kato-Katz thick smears ($r=0.77$, $p<0.001$) than did "blood in urine" ($r=0.23$, not significant). When compared to reagent stick testing, "blood in urine" gave a higher correlation than "schistosomiasis" ($r=0.75$, $p<0.001$ vs $r=0.42$, $p<0.01$).

Inter-country comparisons of the correlations

Since schistosomiasis is a very focal disease, its prevalence will vary considerably between individual schools in the same setting. It is important to know that the relationship between prevalence and the percentage of positive answers in questionnaires holds true at different levels. Regression lines were drawn for the relationship between the school positivity rates for the "blood" or "schistosomiasis" questions, and the school haematuria prevalence (Fig.5). They had a similar slope in all the countries except Zambia, where there was a group of 10 schools with low haematuria prevalences but high rates of positive answers for "schistosomiasis", which resulted in the regression line being flatter. There was no obvious reason for this finding. Interestingly, the slope for the percentage positivity for the "schistosomiasis" question versus *S.mansoni* prevalence in Zaire was similar to the others. On average, children in Congo gave the lowest percentage of positive responses at a given haematuria prevalence rate, while children in Malawi gave the highest percentage.

Table 5 gives a summary of the overall results for each country. From the figures in this table, an analysis was made in order to compare between countries the influence of the haematuria prevalence rate on the results for the two "key questions." The results are shown in Fig.6. There is a good linear correlation between the overall country haematuria prevalence and the overall country percentages of positive answers to "schistosomiasis" ($r=0.90$, $p<0.01$) or "blood in urine" ($r=0.93$, $p<0.01$). However, although the increase in the number of positive answers with increasing prevalence is consistent at a country level, as well as at the school level (Fig.6) there are countries where the response rates to a given question are somewhat higher when the actual level of prevalence is similar (e.g. compare Malawi and Cameroon). However, these differences are not very marked.

Table 5: Children's questionnaire: correlation between questionnaire answers and biomedical testing.

	Cameroon	Congo	Ethiopia	Malawi	(Sm)	Zaire (Sh)	Zambia	Zimbabwe
"Best question"	blood	blood	pain	schisto	schisto	blood	blood	schisto
Correlation*	0.70	0.83	0.20	0.49	0.77	0.75	0.37	0.54
1+ Positivity	p<0.001	p<0.001	NS	p<0.001	p<0.001	p<0.001	p<0.0	p<0.001
Correlation*	0.70	0.78	0.22	0.51	NA	NA	0.39	0.56
2+ Positivity	p<0.001	p<0.001	NS	p<0.001			p<0.01	p<0.001
No.schools	60	53	24	52	58	48	57	49

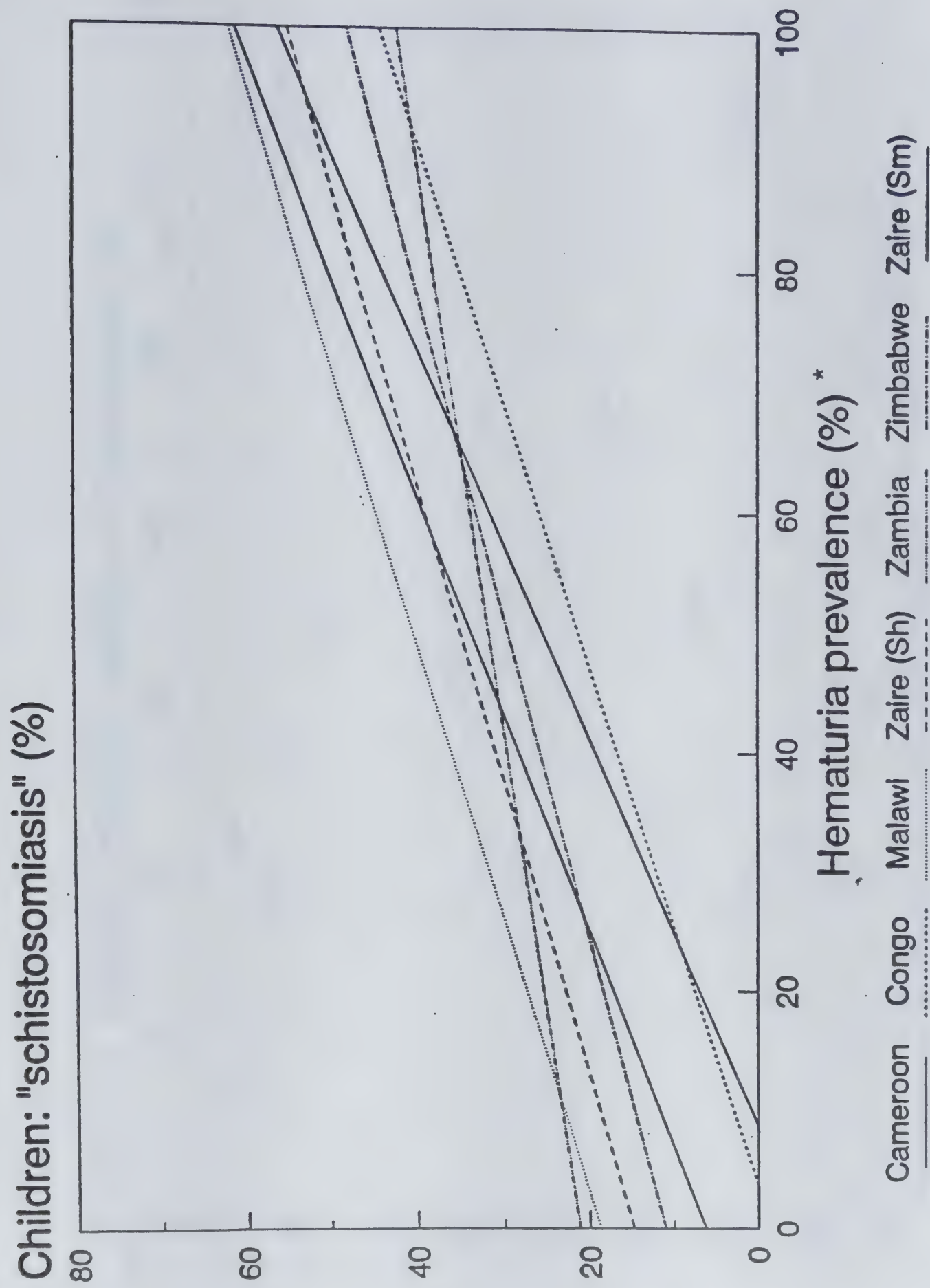
* Pearson correlation. NS=Not significant. NA=Not Applicable.

Sm = S.mansoni; Sh = S. haematobium.

"schisto"; child reported having had schistosomiasis:"blood" ; blood in urine: "pain"; pain on urinating.

Note: The overall rates were calculated for different samples; the percentage of positive answers was calculated for all schools that returned questionnaires, whereas the rate of haematuria was from the sub-sample of schools where testing was done. However, the questionnaire response rates were within 3% of each other in the two samples.

Figure 5



* Also *S. mansoni* prevalence in Zaire

Figure 6 a

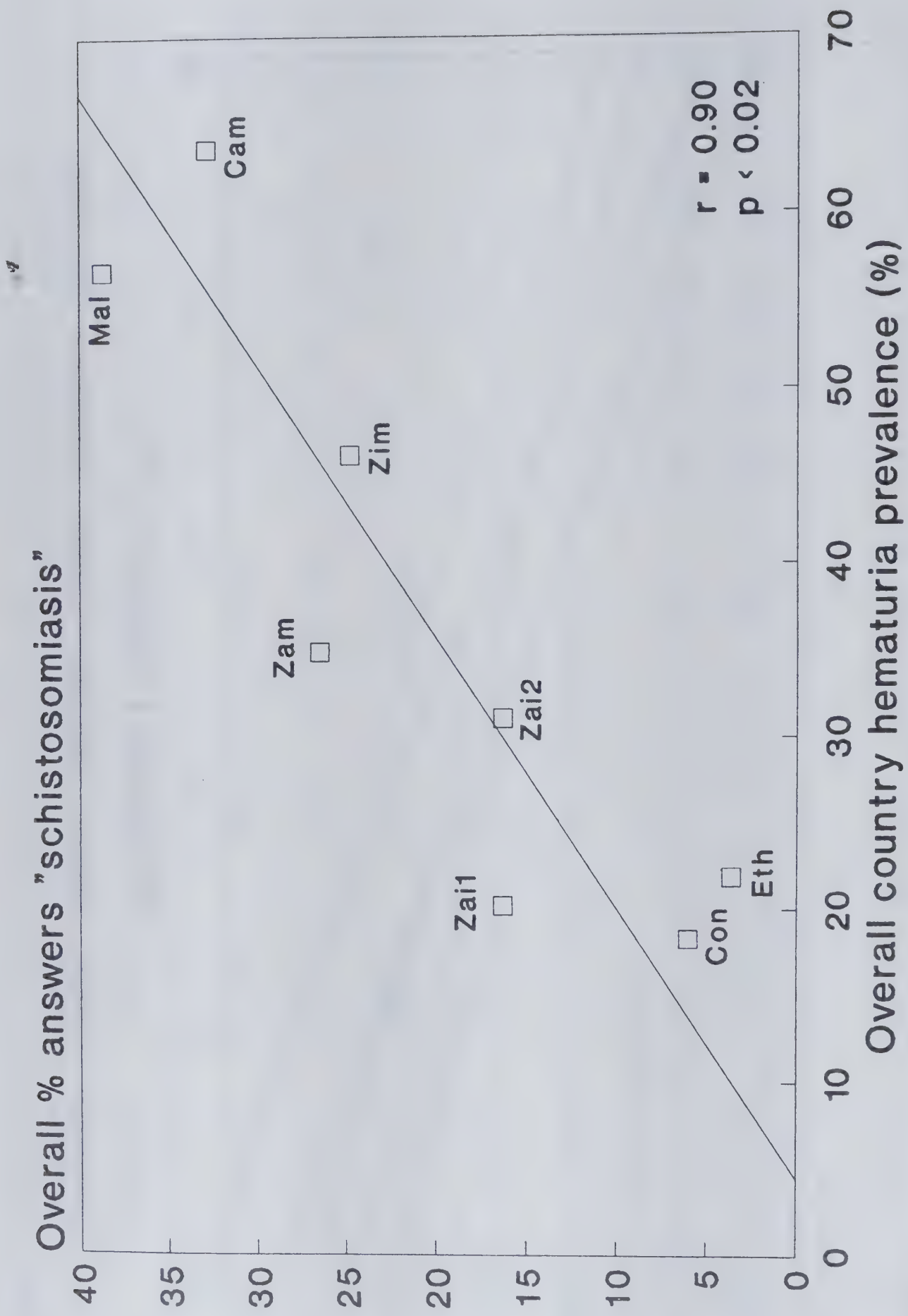
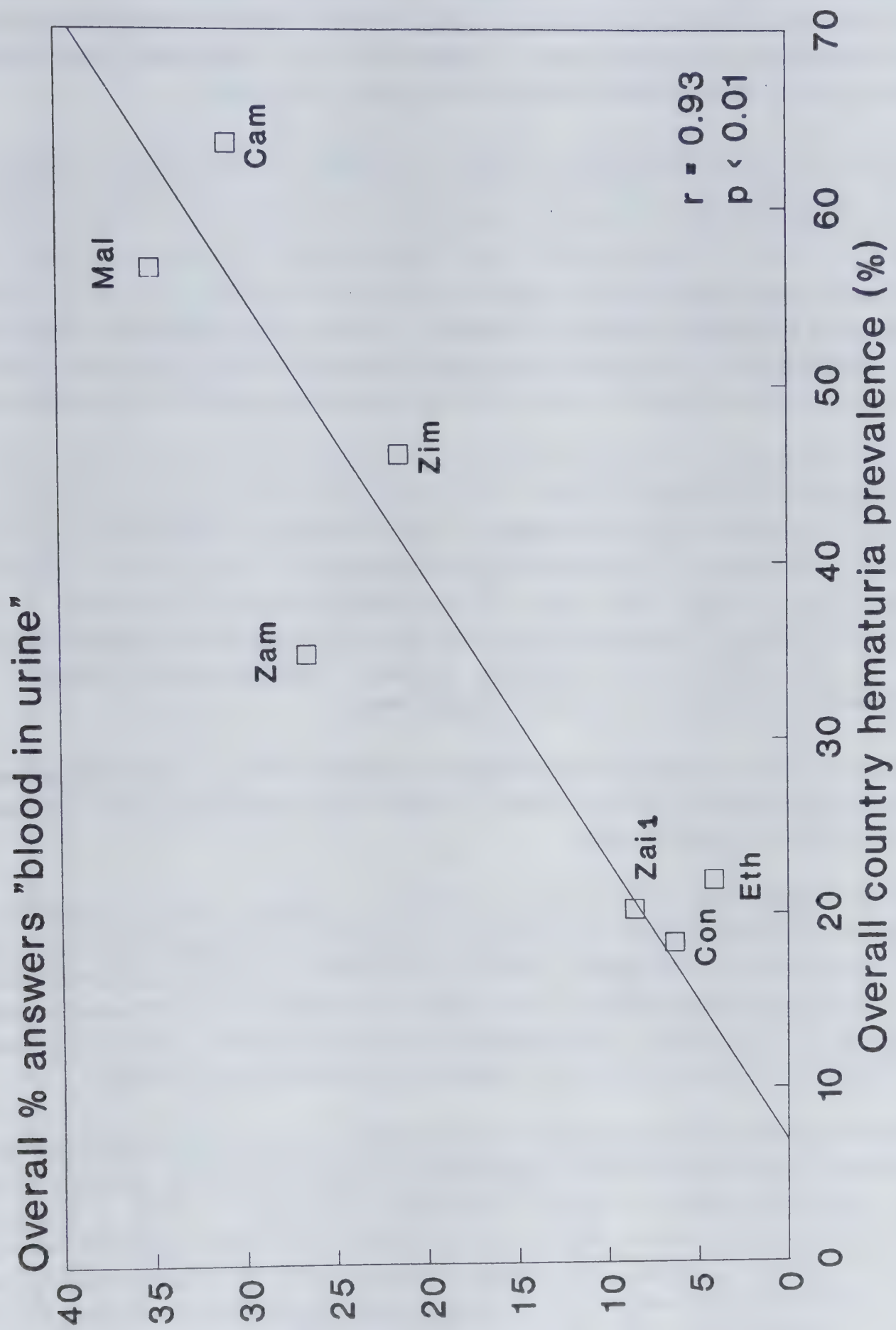


Figure 6 b



4.4 The teachers' questionnaire

The teachers' questionnaire did not give school-specific rates for symptoms or diseases, as the children's questionnaire did, but relative ranks. As with the children's questionnaire, "schistosomiasis" among the diseases, and "blood in urine" among the symptoms, were of primary interest for the present study. The teachers had to make their choice from a list of 11-12 items, and to rank 6 items from that list in each question. When an item was not cited at all by the respondent it was given the rank 7. There was also an "open-ended" question asking respondents to name diseases which should have priority for control.

A summary of the main results is given in Table 6. It includes the median rank of the relevant items, the percentage of teachers who put the relevant items in positions 1-4, and the percentage of teachers who put the relevant item as their first choice. Results vary widely. The items "blood in urine", "schistosomiasis" and "schistosomiasis as priority for control" often had a low median rank, between 6 (the lowest possible on the list) and 7 (not cited). Overall, the teachers gave the highest ranking in Zimbabwe. The item "schistosomiasis" had a higher rank than "blood in urine" in all countries except Zambia. However, as the lists of items to choose from were country-specific, direct comparisons between countries are not possible.

The results of the Spearman tests done to assess the correlation between the items of interest in the three questions are shown in Table 7. The correlations between the ranks given to the three relevant items were high in Cameroon, Congo, Malawi and Zimbabwe, suggesting a good internal consistency of the results. In Ethiopia and in Zaire the two correlations involving "blood in urine" were low. In both countries this could be related to a low prevalence and intensity of haematuria (which was shown by reagent-stick measurements). In Zambia, it was mainly the correlation between "schistosomiasis (disease)" and "schistosomiasis as a priority for control" that was weak.

The question giving the best Spearman Rank correlation with the measured haematuria prevalence in each country is shown in Table 8. Overall, the correlations were much weaker than for the children's questionnaire.

Although the median rank given to "schistosomiasis" or "blood in urine" is generally low when results for the whole country are considered (Table 6), teachers gave "schistosomiasis" a priority among the top 4 diseases in more than 25% of the schools, so schistosomiasis is evidently seen as a serious problem in many places. In answer to the open-ended question about diseases to be controlled, schistosomiasis was cited frequently, and in all countries except Ethiopia it was among the "top 4" diseases in over 20% of the schools.

An informative picture is given by Fig.7, which shows the cumulative ranking of the item "schistosomiasis" by the teachers in the seven countries. This graph clearly separates the three countries with high endemicity (overall haematuria prevalence $> 45\%$ = Cameroon, Zimbabwe, Malawi) from the four moderate to low endemicity countries (overall haematuria prevalence $< 35\%$ = Zambia, Zaire, Congo, Ethiopia). In the four latter countries, more than 58% of the teachers did not include "schistosomiasis" in their lists at all (rank 7). From this result it is apparent that even a median rank of 5 or 6 for "schistosomiasis" is probably adequate to separate high endemicity countries from those with moderate to low endemicity. This could provide a simple but powerful preliminary indicator of endemicity.

Table 6 : Main teachers' questionnaire results. The median ranks of the relevant questions, as well as the percentage of times they were cited among the top four, or given the top rank, are given.

	Cameroon n=99	Congo n=58	Ethiopia n=28	Malawi n=85	Zaire n=136	Zambia n=87	Zimbabwe n=110
<u>"Blood in urine"</u>							
Median rank	6	7	7	6	7	5	5
% in top 4 answers	32.0	8.6	3.6	28.9	3.7	40.7	43.6
% of rank one	8.0	1.7	0	4.8	0.7	17.4	12.7
<u>"Schistosomiasis"</u>							
Median rank	3	7	7	4	7	7	4
% in top 4 answers	73.0	19.0	10.7	49.4	27.9	37.2	55.5
% of rank one	11.0	1.7	0	3.6	4.4	9.3	16.4
<u>"Priority for control"</u>							
Median rank	--	7	7	5	7	4	3
% in top 4 answers	--	22.4	14.3	43.4	23.5	48.8	62.7
% of rank one	--	5.2	0	9.6	2.2	9.3	21.8

Table 7: Spearman rank correlation coefficients for the relationships between the items of interest in the 3 teachers' questions.

	Cameroon n=99	Congo n=58	Ethiopia n=28	Malawi n=83	Zaire n=136	Zambia n=86	Zimbabwe n=110
Agreement schisto-blood	0.52	0.75	0.00	0.61	0.44	0.55	0.73
Agreement schisto-control	--	0.85	0.82	0.73	0.71	0.33	0.74
Agreement blood-control	--	0.59	0.34	0.69	0.23	0.55	0.67

Schisto = schistosomiasis (as disease).
 Blood = blood in urine.
 Control = schistosomiasis as disease needing to be controlled.

Note: the p values for the correlations are not given because it was felt that a formal significance testing was not appropriate to compare relative rankings (since the ranks depended for each question on the mix of proposed items on the list). Furthermore, the answers in the first question are likely to influence the answers to the next one (auto-correlation) and they are therefore not truly independent.

Table 8: Correlations between teachers' questionnaire results and biomedical testing.

	Cameroon n=60	Congo n=53	Ethiopia n=24	Malawi n=52	Zaire(Sm) n=58	Zaire(Sh) n=48	Zambia n=57	Zimbabwe n=49
Best teacher question	"schisto"	"schisto"	"schisto"	"blood"	"schisto"	"schisto"	"blood"	"control"
1+ Positivity *	-0.39 p<0.01	-0.62 p<0.001	0.20 NS	-0.48 p<0.001	-0.59 p<0.001	-0.31 p<0.05	-0.39 p<0.01	-0.24 NS
2+ Positivity *	-0.41 p<0.001	-0.60 p<0.001	0.29 NS	-0.55 p<0.001	NA	NA	-0.41 p<0.001	-0.31 p<0.05

* Spearman rank correlation.
 NS=Not significant. NA=Not Applicable.
 "schisto" = schistosomiasis, "blood" = blood in urine.

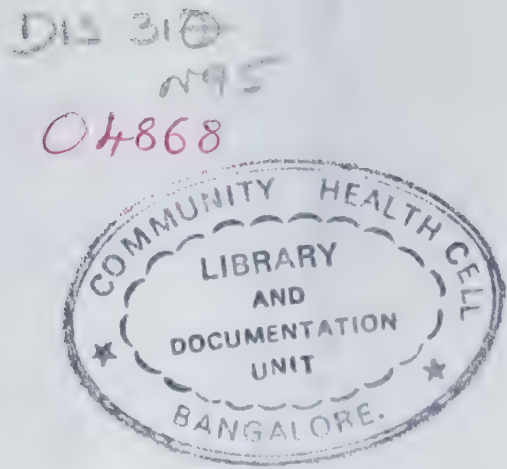
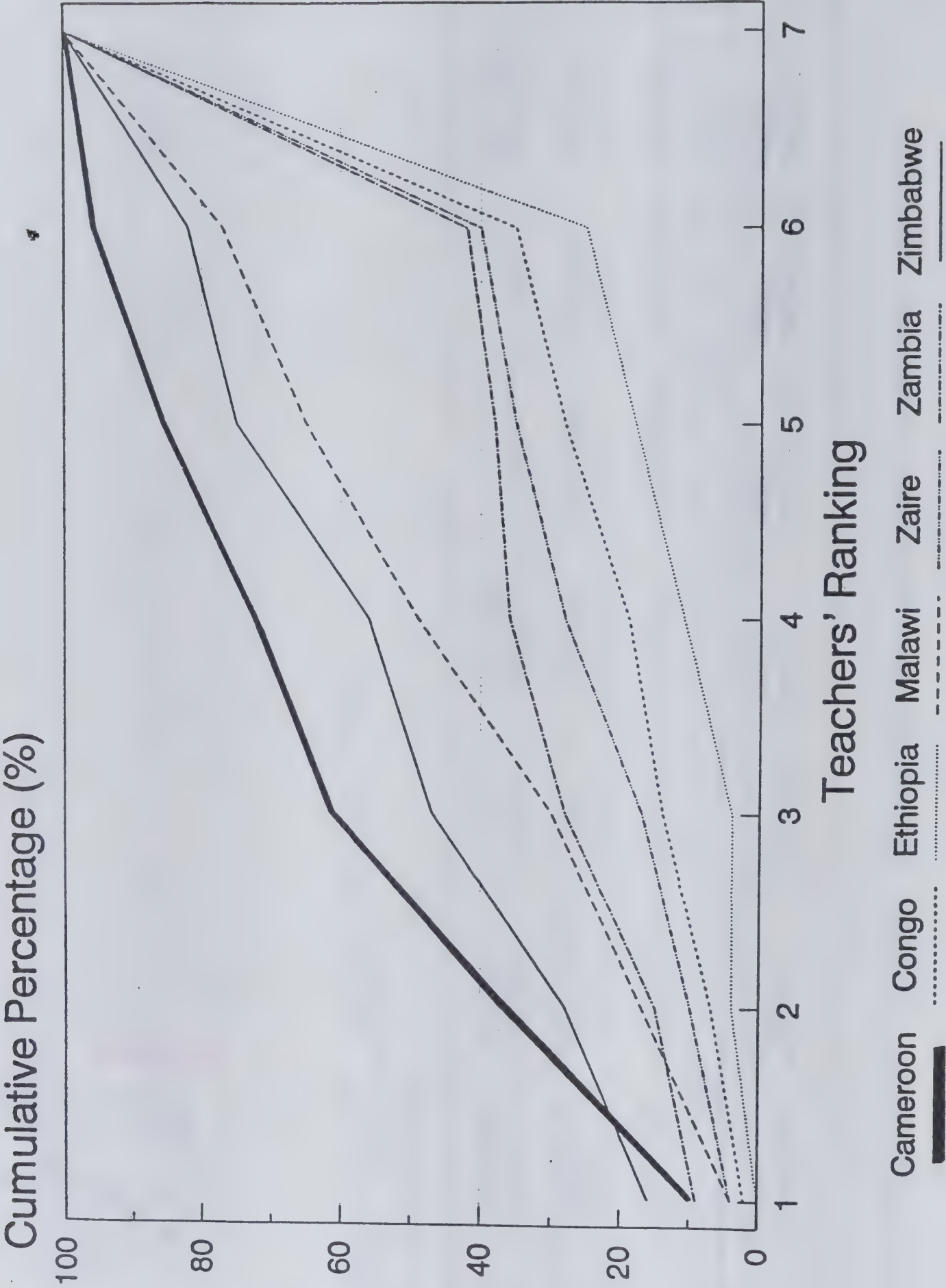


Figure 7



Inter-country comparison of the teachers' questionnaire results

The relationship between the proportion of teachers who gave "schistosomiasis" or "blood in urine" a priority among the top 4, and the overall country haematuria prevalence rate, is shown in Fig.8. For the answer "schistosomiasis" the linear correlation coefficient was very high ($r=0.93$, $p<0.01$). This picture complements Fig.7, and confirms that the rank given by the teachers to the disease is strongly dependent on endemicity. The fact that the points are all close to one line indicates that the perception of the importance of the disease is comparable in very different socio-cultural environments. A similar picture was obtained for schistosomiasis as a disease to be controlled (question 3, open-ended; results not shown), although the correlation coefficient was not as high ($r=0.77$, NS).

4.5 Comparison between teachers' and children's questionnaires

In four countries, the Spearman rank correlation test showed that the correlations between the teachers' and the children's questionnaire for both "schistosomiasis" and "blood in urine" were highly significant (Table 9). In general the correlations were better for "schistosomiasis" than for "blood in urine". In Congo the agreement was not good for "blood in urine" while in Zambia the agreement was not significant for "schistosomiasis". In Ethiopia it was poor for both questions.

4.6 Specific Gender analysis

It was important to examine how far gender had to be allowed for in assessing the results of the questionnaire procedure. Some qualitative observations suggested that there might be differences. It is possible that for purely anatomical reasons girls notice blood in urine less - or that for cultural reasons they are reluctant to report it. For example, in Ethiopia girls were reported to have been shy about answering the questions.

Detailed sex-specific data on both questionnaire answers and reagent stick testing were available for two countries: Cameroon and Malawi. In Cameroon, all the data came from the same 60 schools. In Malawi, the questionnaire results came from all 85 schools, but the haematuria rates were only calculated for the 54 schools in which the teachers performed urine testing. However, the questionnaire results in both samples were almost identical. For Zaire, the available data come from very different samples, so the questionnaire rates should not be compared to the haematuria rates.

The results by gender are given in Table 10. In Cameroon, all the gender differences were large and significant. The haematuria prevalence for boys was 13.7% higher than for girls. The differences in the percentage of positive answers were, however, even larger; 17.7% for "schistosomiasis" and 20.0% for "blood". Cameroon was also the country with the most

Figure 8 a

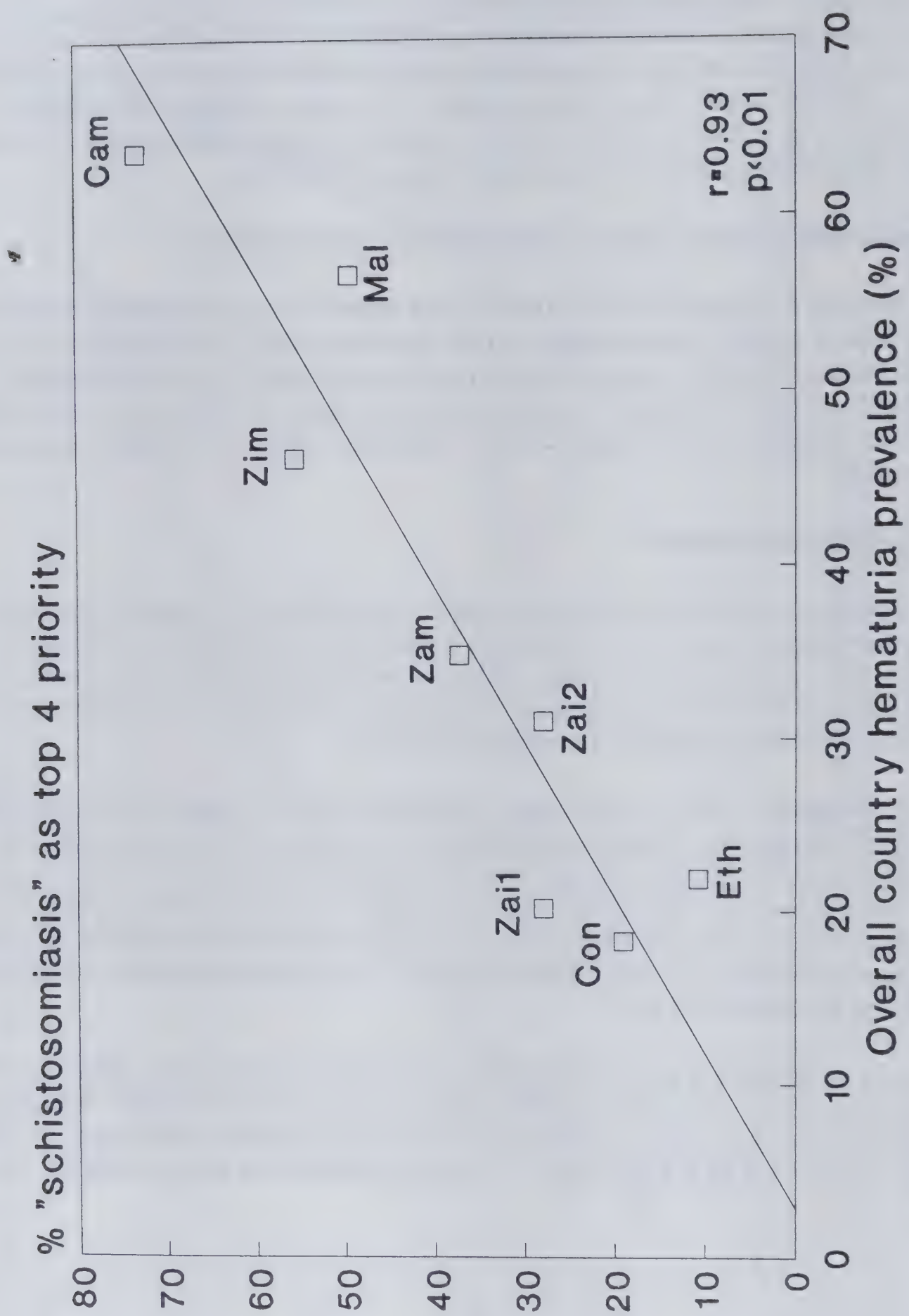


Figure 8 b

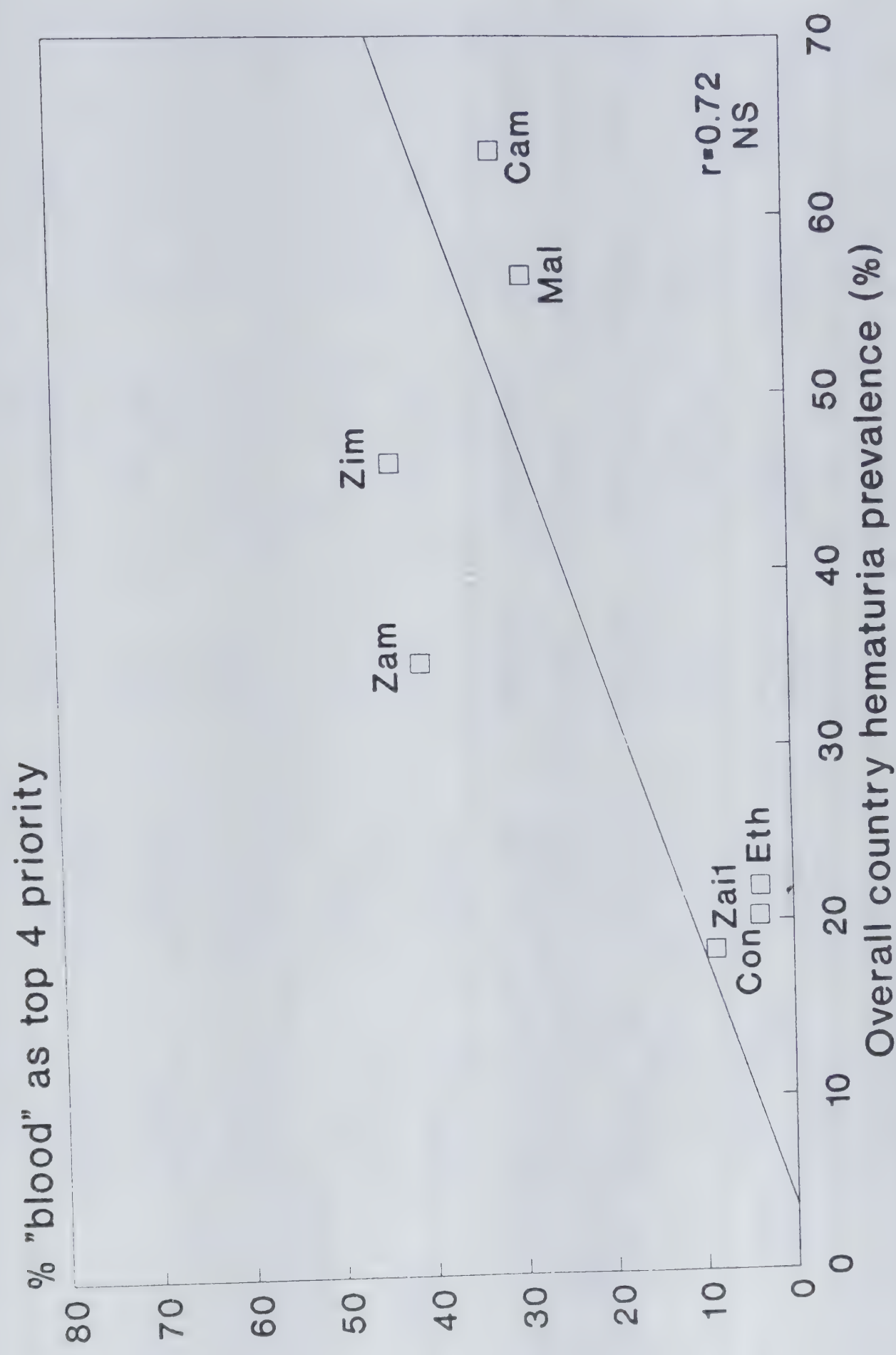


Table 9: Correlations between the answers of the teachers and the children. 4

No. of schools	Cameroon n=99	Congo n=58	Ethiopia n=28	Malawi n=83	Zaire n=132	Zambia n=83	Zimbabwe n=110
Agreement* on blood in urine	-0.49 p<0.001	-0.12 NS	-0.34 NS	-0.54 p<0.001	-0.55 p<0.001	-0.38 p<0.001	-0.52 p<0.001
Agreement* on schistosomiasis	p<0.001	-0.54 p<0.001	-0.60 NS	0.02 p<0.01	-0.33 p<0.001	-0.80 NS	-0.18 p<0.001

* Spearman rank correlations
NS=Not significant.

Table 10: Gender-specific questionnaire and reagent stick testing results for Cameroon, Malawi and Zaire.

	Sex		Difference of rates	p value difference	Q. answers as % of haematuria	
	male	female			male	female
a) Cameroon (106 schools)						
Schistosomiasis %	37.4 1762/4705	19.7 318/1615	17.7	p<0.001	56	38
Blood in urine %	35.5 1689/4756	15.5 250/1617	20.0	p<0.001	54	30
Haematuria %	66.0 3090/4684	52.3 759/1451	13.7	p<0.001		
b) Malawi (85/54 schools)						
Schistosomiasis %	46.3 1913/4134	30.8 871/2827	15.5	p<0.001	79	58
Blood in urine %	42.5 1759/4134	27.2 770/2827	15.3	p<0.001	72	51
Haematuria %	58.8 1696/2885	53.4 1039/1946	5.4	p<0.001		
c) Zaire (36/21 schools)						
Schistosomiasis %	30.2 750/2480	30.9 673/2176	0.7	NS		
Blood in urine %	17.8 441/2480	11.6 252/2176	6.2	p<0.001		
Haematuria %	29.8 175/587	29.9 150/502	0.1	NS		
<u>S. mansoni</u> %	37.1 433/1166	40.6 416/1025	3.5	NS		

The questionnaire response rates for "schistosomiasis" and "blood in urine" are shown. "Haematuria" refers to haematuria (≥1+) as measured by the teachers. NS=Not significant.

unbalanced male:female sex-ratio (3.1). In Malawi, the difference between measured haematuria rates was much smaller (5.4% more in boys), but the response rates varied much more; 15.5% more boys than girls said they had had schistosomiasis, and 15.3% more reported "blood in urine". In Zaire the results showed no gender difference, except that at the same level of measured haematuria, the girls reported blood in urine 6.2% less frequently.

In Cameroon, the male questionnaire positivity rates were about 50% of the measured haematuria prevalence among boys, while the girls' answer rates were only around 30% of the infection rate. In Malawi, the boys' questionnaire positivity rates were about 80% of the haematuria prevalence, while the girls' rates were only about 50%. There was thus a clear tendency in both these countries for girls to report less often that they had had blood in urine, or schistosomiasis, whether or not the prevalence of infection was strikingly different between the sexes. In Zaire, the girls reported having had schistosomiasis almost as often as the boys, but they did report "blood in urine" a little less often. However, the data for Zaire are less complete, and the presence of *S.mansoni* makes the situation more complicated.

Some differences might have been due to a lower intensity of infection among girls, so that they were less likely to notice symptoms or be aware of having the disease. Nevertheless, the results make it clear that possible gender differences in the questionnaire response rates are a factor that should not be ignored.

4.7 The diagnostic performance of the children's questionnaire

Definition of high-risk limit

The purpose of using questionnaires as a diagnostic tool is to identify communities in which the level of infection is such that they need special attention. This prevalence is defined as the "intervention threshold" or "high-risk limit". As discussed earlier (Section 1.4), for schistosomiasis there is not a "standard" prevalence above which a treatment campaign is recommended. The "high-risk limit" in a particular setting will depend upon such factors as the overall prevalence pattern, the available resources and the perceived importance of the disease. In this study, the limits were therefore set independently in each country, according to local priority criteria. They ranged from 20% haematuria ($\geq 1+$) in Congo, to 55% haematuria ($\geq 1+$) in Cameroon and Malawi (Table 11). In practice, the cut-offs were largely set according to the overall country haematuria prevalence.

Determination of questionnaire positivity threshold

The second step was to determine the questionnaire positivity threshold. This is the level at which a school is defined as being "positive" on the basis of questionnaire answers. It was defined after choosing the optimum sensitivity/specificity combination in each setting. The threshold varied from 7% positive answers in Congo, to 30% positive answers in Malawi (Table 11). In each country, only the question that gave the best correlation with biomedical testing (Table 5) was considered.

Table 11:Diagnostic performance of the questionnaires (best question for each country). Ethiopia excluded.

	Cameroon n=60	Congo n=53	Malawi n=54	Zaire n=60		Zambia n=58	Zimbabwe n=49
Low-risk/high-risk cut-off (haematuria $\geq 1+$)	55%	20%	55%	50% KK ¹	30% RST ²	45%	47 ³
CHILDREN'S QUESTIONNAIRE Questionnaire positivity threshold	20% "blood"	7% "blood"	30% "schisto"	20% "schisto"	15% "blood"	20% "blood"	25% "schisto"
Prevalence (pos.schools)	66.7	25.9	53.7	26.3	28.6	29.8	53.1
Sensitivity	97.5	93.3	93.1	93.3	85.7	70.6	92.3
Specificity	35.0	81.6	46.0	69.0	85.7	72.5	56.5
Positive pred. value	75.0	63.9	66.6	51.8	70.6	52.1	70.6
Negative pred. value	87.5	97.2	85.2	96.7	93.7	85.3	86.6
TEACHERS' QUESTIONNAIRE Questionnaire positivity threshold	Rank 4 "schisto"	Rank 6 "schisto"	Rank 6 "schisto"	Rank 6 "schisto"	Rank 6 "schisto"	Rank 5 "blood"	Rank6 "blood"
Prevalence (pos.schools)	67.9	25.9	51.9	25.9	29.2	29.3	53.1
Sensitivity	86.8	86.7	96.3	86.7	78.6	76.5	76.9
Specificity	50.0	81.6	48.0	58.1	55.9	63.4	43.5
Positive predictive value	78.6	62.2	66.6	42.0	42.3	46.4	60.6
Negative predictive value	64.2	94.6	92.3	92.6	86.3	86.7	62.5

¹ KK = Kato-Katz, ² RST = Reagent-stick testing ³ Equivalent to 35% haematuria ($\geq 2+$)
"schisto" = schistosomiasis, "blood" = blood in urine.

Calculation of diagnostic performance

Once these two limits had been defined, the diagnostic performance could be calculated using Bayesian statistics. Predictive values were calculated using the formulae given by Galen & Gambino (1975).

Because the questionnaires have a primary screening function, the emphasis was put on obtaining high sensitivity and thus increasing the negative predictive value. This was important in order to ensure that the schools excluded on the basis of the questionnaire testing had a high probability of being really negative. Lower positive predictive values were obtained as a result. This led to the inclusion of schools that were not high-risk schools, but it was felt that though this could lead to some waste of resources, it was less serious than missing high-risk schools and hence large numbers of infected children. Therefore sensitivity was set above 85 % in all the countries except Zambia.

The prevalences used to calculate the predictive values were those of positive schools, rather than positive individuals, since the questionnaires screened schools rather than individuals.

Results

Table 11 summarizes the main diagnostic performance results for the children's questionnaire in six countries. Ethiopia is not included, because the questionnaires had clearly not worked there. For Zaire, two separate calculations were performed, one for the validation by reagent stick testing, and one for the validation by Kato-Katz testing.

Negative predictive values were above 85 % in all 6 countries, and in 3 countries the negative predictive values were above 90 %, indicating a very good reliability in excluding low-risk schools. In all the countries the positive predictive values were lower but acceptable. The results in Zambia were considered to be just good enough for recommending the questionnaire screening method.

The conclusion was that the questionnaires had proved to be a reliable way of identifying schools with a high prevalence of schistosomiasis in six countries. They had worked for both species of schistosomiasis in Zaire.

4.8 The teachers' questionnaire; results and diagnostic performance

The teachers' questionnaire, like the children's, was tested as a possible method for identifying high-risk schools. The results are given in Table 11. The questionnaire positivity threshold was rank 6 for all but two countries. This meant that a school was considered to be positive when either "schistosomiasis" or "blood in urine" was mentioned at all in the priority list.

The diagnostic performance of the teachers' questionnaire was found consistently to be lower than that of the children's. The lower diagnostic performances reflected the lower correlations between the teachers' questionnaire and the biomedical testing (Table 8). However, though the teachers' questionnaire does not appear to be as powerful a diagnostic instrument as the children's, it gives information which can be most valuable for priority setting, which is another important aspect of community diagnosis.

4.9 Financial analysis

A simple financial analysis was undertaken in five of the seven countries. (The results for Malawi and for Zaire are missing.) The costs for approaches involving reagent-stick testing by teachers could not be calculated for Zambia, where the testing was done by the survey team. Table 12 gives the essential costing figures for four approaches:

- 1 Questionnaires alone
- 2 Teacher reagent stick testing alone
- 3 The two steps in succession
- 4 Estimated cost of conducting a similar survey with a conventional vertical programme approach using parasitological testing.

The cost per school screened with questionnaires varied from 7 US\$ in Congo to 47 US\$ in Ethiopia. For teacher reagent stick testing, the cost varied from 48 US\$ to 153 US\$ per school. The estimates for the two steps carried out in succession varied from 51 US\$ in Congo to 178 US\$ in Ethiopia. Execution times were not available for the two-step approach.

Although the costing procedures were discussed during two workshops, this aspect of the study was not dealt with in sufficient detail for the results to be truly comparable. For example, the costing basis for salaries and transport was not always made explicit. Some omissions also contributed to the distortion of the figures; for example, the Congo team did not include the full cost of transport for the different phases and thus came out with lower estimates than the other teams.

Intra-country comparison is also difficult because the conditions in which the studies were conducted varied widely. For example, the Ethiopian team worked far away from their base and with a small number of schools. Distances were also long in Zambia and to a certain extent in Cameroon. Such conditions are likely to lead to a high cost per school, as was shown in the two original studies in Tanzania, where the costs within one country were found to be 3.5 or 6.3 US\$ per school screened according to the district in which the work was done (Lengeler et al., 1991 a&b).

The estimates for the cost of the first three approaches were considerably lower than the estimated cost of traditional "vertically organized" parasitological testing. No allowance was made in the analysis for the fact that the first three approaches could be carried out by district health teams, which is unlikely for approach four. Additional benefits such as the educational impact of the different approaches were also ignored.

Table 12: Costing of the different approaches in 5 countries. All costs in US \$.
Results for Malawi and Zaire not available

Approach	1. Question- naire	2. Teacher testing	3. Two-step method	4. Traditional parasitol. method
<u>Cameroon</u>				
Cost per school	33	104	92	218
Time (weeks)	5	4	NA	11
Times cheaper	6.6	2.1	2.4	1.0
<u>Congo</u>				
Cost per school	7	48	51	196
Time (weeks)	2	4	NA	12
Times cheaper	28.0	4.1	3.8	1.0
<u>Ethiopia</u>				
Cost per school	47	153	178	226
Time (weeks)	4	2	NA	6
Times cheaper	4.8	1.5	1.3	1.0
<u>Zambia</u>				
Cost per school	41	--	--	83
Time (weeks)	(24)	--	--	4
Times cheaper	2.2	--	--	1.0
<u>Zimbabwe</u>				
Cost per school	11	108	59	200
Time (weeks)	5	7	NA	24
Times cheaper	18.2	1.9	3.4	1.0

NA = not available

5. DISCUSSION and CONCLUSIONS

5.1. The use of diagnostic questionnaires for screening

Identification of high-risk areas for urinary schistosomiasis

The central result of the present study was that in six out of seven countries; Cameroon, Congo, Malawi, Zaire, Zambia and Zimbabwe, there was a good correlation between the answers to the children's questionnaire and the prevalence of haematuria as measured by reagent stick testing. In each of these countries a positivity threshold was defined in terms of the percentage of positive answers to the question giving the best correlation, and this was used to calculate the power of the questionnaire to assign a school to the "low-risk" or "high-risk" group. The groups were defined in terms of the haematuria prevalence at which intervention was considered desirable - this was specific for each country, depending on the local situation and priorities.

The negative predictive values calculated on this basis were high, ranging from 85.2-97.2%. The positive predictive values were lower (51.8-75.0%), but acceptable, in the six countries. The high negative predictive values mean that questionnaires can reliably identify "low-risk" schools and hence "low-risk" communities. These can then be set aside, at least in the first phase of an intervention, allowing the available resources to be concentrated on the "high-risk" ones. The rather lower positive predictive values mean that a small number of schools with lower prevalence would be included as well. However, since the cost of this approach is low, the benefits from using it to exclude a large number of communities initially from a control programme are likely to repay the initial investment.

With the teachers' questionnaire, the correlations examined were those between haematuria prevalence and the ranking of schistosomiasis and its symptoms as important health problems. Significant correlations were obtained in all countries except Ethiopia, though in Zimbabwe the correlation was only significant when haematuria prevalences at the $\geq 2+$ level were used.

The diagnostic performance of the teachers' questionnaire was, however, less good than that of the children's questionnaire. This confirms the earlier results from Tanzania. As a result, the emphasis in the analysis was laid on the capacity of the teachers' questionnaire to provide an overall assessment of endemicity, and to relate endemicity to priority ranking.

The relationship between the haematuria prevalence rate and the rate of positive responses to the children's questionnaire was similar in five of the countries in which the questionnaire approach worked well (Figs 5 & 6). This was a surprising finding, since we expected the relationship between the biomedically measured prevalence of the disease in an area, and its perception by the people living there, to be rather different in different ecological and cultural environments. The similarity we found provided evidence that the perception of the disease is likely to be based on "objective" morbidity criteria, since it was perceived in such a homogeneous way. It suggests also that the questionnaire approach is rather robust and that the extension of its use to a completely different setting is likely to be successful.

With the teachers' questionnaire, the relationship between a high prevalence of haematuria, and schistosomiasis being given a high rank as a disease to be controlled, was also consistent

between countries (Fig.8b). However, there do seem to be some country-specific differences in the perception of the importance of the symptom "blood in urine" by the teachers. In the three countries with low overall haematuria prevalence rates, and low intensities (Congo, Ethiopia, Zaire) they mentioned blood in urine infrequently as a symptom in schoolchildren, which is to be expected. However, in the four countries with a higher overall haematuria prevalence rate, the relationship between prevalence and the ranking given to the symptom by the teachers was not consistent; in Malawi and Cameroon, the countries with the highest haematuria rates, the symptom "blood in urine" was given a lower priority than in Zambia and Zimbabwe (Fig.8b).

There were also some differences in the responses of boys and girls in the three countries where data were available to analyse this (Section 4.6). In situations where the prevalence in both sexes was similar, girls responded to the questions about "blood in urine" and to a lesser extent "schistosomiasis" differently from boys. This could be related to a different perception of the disease in the framework of perceived well-being, as suggested by Parker (1993). It could also be related to anatomical differences, that produce different patterns and intensities of chronic pain, or simply make the observation of haematuria more difficult for girls than for boys. Girls may also react differently to questions about haematuria for cultural reasons (Amazigo, 1993). The gender question should be taken into account during data analysis.

The questionnaire approach for intestinal schistosomiasis

The data from Zaire proved that the questionnaire approach was also able to identify foci of intestinal schistosomiasis, by the question "Did you have schistosomiasis". Multiple regression analysis confirmed that the results were not due to a confounding by urinary schistosomiasis, but that the observed correlations were likely to be true. This is an important finding, since screening for this disease is much more difficult than for urinary schistosomiasis. Intestinal schistosomiasis is spreading in Africa as a result of water development programmes and is likely to be an increasing problem in the future (WHO 1993).

At present, we do not understand how children perceive that they are infected by the disease. The findings were not anticipated at the start of the study, and unfortunately no in-depth analysis of the disease perception patterns was included. It was not possible from our data to relate the answers of individual children and their test results. Two studies (in Zaire and Ethiopia) have been launched recently with the support of TDR to address these issues.

One important finding was that a comparison of the percentages of the positive answers, "I had blood in my urine" and "I had schistosomiasis", is likely to be a very good indicator of the presence of intestinal schistosomiasis in an area of mixed infections. In areas with only urinary schistosomiasis the rates for the two responses are very similar, whereas in Zaire, where intestinal schistosomiasis was also present, there was a much higher rate for "I had schistosomiasis".

Countries where the approach was less successful

In Ethiopia, the questionnaire approach did not work well. The possible reasons included some specific local problems, like reluctance to answer questions (Section 3.4.3). However, there were also difficulties connected with the endemic situation and the perception of the disease,

which might apply to other countries with similar situations. The reagent stick testing showed that the disease had a similar prevalence to that in Congo or Zaire, but this was not reflected in the questionnaire answers. The main reason was that there were more mild infections, so that the concentration of blood in the urine was low (mean intensity of positives in reagent-stick testing was 1.42, compared to more than 2 in other countries; Table 4), so that "blood in urine" was not perceived. In addition, only a small minority of teachers and children seemed to know about bilharzia, as the disease is called in Ethiopia, and there were a large number of "I don't know" responses to the question "Have you had bilharzia?". The lack of knowledge about the disease could be because children came mainly from immigrant families from the highlands, where the disease is not endemic, which may be why the disease is not well recognised. Interestingly, the indigenous Afar pastoralists do have a name for schistosomiasis (Dahogera) which means literally "blood in urine", but few Afar children attend school, so only a few of them were included in the present study. The teachers suggested that if a seminar could be organized beforehand in order to explain the terms that were not well understood the questionnaire approach might be more efficacious. This would add to the cost of the approach.

In Zambia, the results were on the borderline of acceptability. Many possible reasons for this were considered, but so far, no satisfying explanation has been found. There was a group of 10 schools which had a high rate of positive answers to the question, "Did you have schistosomiasis?", but which were found to have low to moderate haematuria rates. This could not simply be attributed to interference by *S. mansoni* infections, since the same picture was seen for "blood in urine". Interference from ongoing control programmes was also unlikely since the schools involved in these had been removed from the sample. Problems during the interviews, of the kind observed earlier in Tanzania, where it was noticed that certain groups of children systematically responded "yes" to every question, could explain this pattern. Systematic data entry mistakes could also not be excluded.

5.2. Operational feasibility of the approach

Questionnaire distribution

Considering the difficult circumstances in which the studies were carried out in most countries, the operational aspects were satisfactory. Work in Africa always faces many external constraints, and any disease control programme may face problems like the floods in Malawi and the badly-planned introduction of mass vaccination of young girls against tetanus in Cameroon and Zaire (Chapter 3). In addition, 1991 was a year with an exceptional number of strikes, political changes and military conflicts in the study countries.

The overall return rate of the questionnaires (89%) and the completion rate of the teacher reagent stick testing (92%) demonstrated that the school system was able to handle this type of activity despite all the problems. Nevertheless, in some countries the teams were obliged to assist key administrative officers with transport and/or per diems so that they could distribute and recover the questionnaires. Such resources would probably not be available if the questionnaire approach was being implemented by a governmental structure, and some external support will probably remain essential for some time. However, whether resources are internal or external there are obvious advantages in new approaches which have been shown to be more cost-effective than the previous ones.

Biomedical testing by teachers

Reagent sticks have been shown to be a satisfactory diagnostic tool for urinary schistosomiasis. When teachers were asked to do the testing they encountered no major problems, and the acceptability of handling urine specimens was reported to be high. The results of cross-checking showed that in four out of the five countries where they did the testing the teachers' results were accurate, as had been found previously in Tanzania. In Ethiopia, however, there were problems, which were most probably related to the extremely low intensity of the haematuria observed in this country. A low intensity makes reading the results more difficult, and is also related to a large day-to-day variability in haematuria prevalence, so that testing done on one day is likely to miss a number of infected children.

5.3. The use of schools as units for screening

Is a school an acceptable proxy for a community?

Since the primary school system was the most extensive administrative system in all the countries, with a distribution largely proportional to the size of the population, working through the school system led to a good coverage of the target population. However, the question arises as to whether a school is an acceptable proxy for the community.

Schools are a good working basis for diseases affecting mainly children of the 6-16 year-old age group, at least in places where the school system is well developed and where the school attendance rate of both boys and girls is relatively high. However, the school approach will be less applicable in places where such conditions are not met, and in such areas school-based results should be interpreted with caution. The approach is certainly not suitable for nomadic populations or populations with very low school-attendance rates. Under such circumstances entirely different approaches will have to be developed. Problems also arise in communities where the school enrolment rate of girls is low, for example in most of the Sahel zone. In areas dominated by the Muslim religion girls are often not encouraged to attend primary school; this was illustrated by the very high male:female sex-ratio (3.1) in the schools in Cameroon.

Relationships between the school system and the health services and the community

There could conceivably have been problems when a health-related survey was carried out through the school system, by teachers rather than by health professionals. It was very encouraging to find that in all seven countries there was no conflict with the health system, and that at district level inter-sectorial activities did seem to be possible. However, the original plan that infected children would be treated by the nearest health services did not work out, and in most sites the team treated the infected children during the cross-checking phase. It is not clear from the available information where the problem lay, but there was an overall feeling among investigators that treatment by the health services would have been difficult to organize.

The feelings of teachers about doing health-related work were also explored. In some countries, such as Congo and Malawi, they felt strongly that their responsibility for the children included concern for health and health education. In contrast, in Zaire it was not

considered as part of a teacher's duties. One question that did arise in some countries was that of payment for teachers for carrying out urine testing. No payment was made to the teachers during the present study, and they generally carried out the testing most efficiently and willingly. Nevertheless, some teachers in Ethiopia, Zaire, Zambia and Zimbabwe did suggest that there should be specific rewards for carrying out urine testing. This is a difficult issue, and might be hard to avoid if a programme is implemented over a longer period, especially in countries where teachers' salaries are low and are often not paid for long periods of time.

In some cases, conflicts arose from the parents' side. In Zimbabwe, for example, the teachers' ability to perform this type of medical work was questioned by some of the parents. Some parents also refused to allow their children to be tested on religious grounds. In the light of this situation, and the problems experienced by the Zairian team with different rumours, the following question must be asked: what safeguards the teacher from possible hostile reactions of members of the community? It seems essential under any circumstances to seek the collaboration and participation of the local health personnel and the support of the local authorities in order to reduce the risk of conflict.

5.4 Involvement of other members of the community in surveys

It is unfortunate that during this multi-country study the original idea of using traditional leaders as key informants was abandoned by all the teams except those in Zaire and Congo. To assess the knowledge and opinion of traditional leaders is fundamental in an approach which implies wide community participation in disease control. There is no doubt that in the African context these leaders can heavily influence the general attitude, perception and behaviour of the community on many issues. It is therefore crucial to have a clear idea of how these leaders of opinion perceive the health problems of their communities. In the countries where responses were obtained from traditional leaders the results were encouraging. In Zaire, out of 530 village leaders, 510 (96.2%) answered their questionnaire within one month. In Congo, 29 village leaders filled in a questionnaire. Because of the troubled political situation, in some places it was not always an easy task for teachers to hand on the forms as requested - but in others, local politicians actually asked to participate in the study, because they wanted to be seen doing something for the common good.

However, it became clear that the problem of choosing and contacting key informants is a difficult one. It has been rendered even more difficult by the introduction of multi-party democracy in Africa. In the present study, the development of a multi-party system was a positive factor in Congo, but it indirectly created difficulties in Cameroon and Zambia. Taking into account the necessity of addressing a range of key informants for the interpretation of priority patterns, how can they be selected in this new context without giving an impression of favouritism? What are practical ways of reaching them in order to ensure the success of the study? Furthermore, how can we ensure that the opinions they express reflect the opinion of the community and not only their own opinion or that of the sub-group they belong to?

Besides traditional leaders and local politicians, there are certainly many other groups and individuals in a community who could make a useful contribution to the discussion. These include, for example, mothers of schoolchildren, and traditional healers. It became clear during the survey that an investigation team needs to work out procedures for identifying and reaching these groups. This requires understanding of the local situation and structures, and

is evidently more complex and time-consuming than working through governmental organizations like the school system. There are also technical problems involved - such as the fact that some important informants may be illiterate - but these should not be insuperable.

The initial study in Tanzania showed that the opinions of the teachers and of the political leaders agreed reasonably well on most diseases (within 2 response ranks) but differed significantly for certain items, including schistosomiasis (Roels, 1993). When different groups in the community have different perceptions of the priority rank of a disease, the implications for control programmes should be evaluated carefully in the local framework.

5.5 The implications for control, and future perspectives

Control strategies based on the new approaches

The use of diagnostic questionnaires, and reagent-stick testing by teachers, are two new methodologies that could prove very valuable in the framework of a district-based control programme.

There is little doubt that for diseases as focal as schistosomiasis, pre-screening is essential in order to prevent the wastage of precious resources on low-risk areas. Furthermore, within a PHC framework, specific control activities should not be initiated in communities where the disease is not perceived as a priority (Tanner et al., 1986). The present results confirm that the perception of schistosomiasis in the community, and the relative priority given to it, are strongly dependent upon endemicity. There is therefore a need for a pre-screening test to identify areas of high disease prevalence that is fast and also inexpensive. We believe that simple questionnaires sent through an administrative system meet both criteria.

The only alternative pre-screening method known to us is the use of existing health statistics. In countries with a good routine recording system health statistics provide a valuable source of information. A study conducted in parallel to that of the questionnaire approach in Tanzania confirmed that district health statistics were useful in determining the overall endemicity of an area (Lengeler et al., 1991a). However, there were only 19 health service facilities in the district compared to 77 primary schools, so the coverage was much lower. In addition, the catchment area of health facilities could not be precisely defined, so it was not possible to get enough information from this source for village-level planning. Aggregated data are, however, very helpful at regional or national level for overall planning purposes and for the initial selection of districts where there seems to be a problem.

It is likely that for some time to come, passive case detection and treatment in existing health services will be the most cost-effective strategy in low-risk areas. Once high-risk areas have been identified, the control strategy could either involve mass treatment of schoolchildren (or of a wider age range) in these communities, or selective chemotherapy based on the identification of infected individuals by reagent stick testing. As has been shown in this study, testing can be satisfactorily done by teachers, which reduces the burden on the health service personnel.

Both strategies - mass treatment, or selective treatment following testing - have their pros and cons, and it is essential for control programme managers to undertake comparative studies to

assess the cost-effectiveness of each of them. For this purpose, a useful framework has recently been proposed by Guyatt et al. (1994). This simple cost menu could enable a health manager (1) to compare different delivery strategies (health services, specialized teams, teachers, etc.) and (2) to determine the endemicity threshold at which mass treatment becomes a more cost-effective strategy than selective chemotherapy. The latter information could then be combined with the questionnaire approach by defining two intervention thresholds instead of only one: "moderate risk", for which selective chemotherapy is likely to be the more cost-effective and acceptable option, and "high risk", for which mass chemotherapy is likely to be the more cost-effective option.

The carrying-out of treatment is a problem that will need to be carefully considered in the planning of future control activities. In the present study, handing over drugs to the teachers for the treatment phase was largely felt not to be possible, for both practical reasons (e.g. worries about correct dosage and side effects) and others (e.g. concern about reliability and the possibility of favouritism).

The application of the questionnaire method to other health problems

The application of the questionnaire methodology to other diseases and health problems for screening purposes has been discussed in detail by Lengeler et al. (1992). Two major constraints will influence the success of such an approach:

- The disease must be selectively and clearly perceived by the respondents. It should also be possible to diagnose it with a biomedical test in order to allow a proper validation. Usually only chronic diseases will fit these requirements.
- There should be a well-functioning administrative system with sufficient coverage to reach the targeted respondents.

So far, little experience is available regarding diseases other than urinary schistosomiasis. The results from Zaire indicate that the survey method is promising for *S. mansoni* infections. However, a method that is as simple as reagent-stick testing is urgently required for detecting *S. mansoni*-related morbidity. There is hope that recent developments in the field of immunoassays (Van Lieshout et al., 1992) will produce tests that are as simple to use as the currently-available pregnancy tests. It is possible that the questionnaire approach might prove useful for chemotherapy programmes for different filariases, for other acute chronic parasitic diseases, and for the assessment of injuries and disability.

The use of questionnaires for priority setting

In conclusion it should be stressed that the questionnaires are not only applicable to diagnosis, but also to priority setting, which is an aspect that tends to be forgotten. For this purpose, they could supply information on a much wider range of problems (Tanner et al, 1993). In addition, because the questionnaire approach is based on community members and institutions, it can play a part in making people aware of problems and thus more likely to be concerned about working towards solutions.

6. THE MULTI-COUNTRY STUDY; EXPERIENCE GATHERED and RECOMMENDATIONS FOR FUTURE STUDIES

6.1 Study design and standardization of data-collection

The overall design of the validation study was found to be satisfactory by all the teams, and there were no serious problems during the field-work and analysis phases. However, multi-country studies inevitably have to deal with subtle differences in the way they are carried out in different countries, even when they are carefully designed and closely supervised, because the socio-cultural setting in each country is different. For example, people's reactions to being questioned, and the way particular questions are answered, vary from place to place. It is almost impossible to establish to what extent such differences might impair the comparability of the results, and we did not attempt to do it.

In the present study, there were also some planned differences in design, arising out of local constraints. As discussed in Section 2.2, the biomedical testing was carried out in five countries by teachers and in two by the team. However, this is unlikely to have created problems, since the teachers' testing was cross-checked and found to be reliable. There were also minor variations in questionnaire design between countries, which are discussed below.

Standardization of the questionnaire procedure

The study group considers that the questionnaires used in the different countries were similar enough in design and content to avoid significant bias. The small variations between the questionnaires used in the different countries are unlikely to have affected the overall results.

One inevitable variation was, of course, in the language used. The asking of questions in a language that the respondent understands is essential for studies dealing with disease perception. Ideally, all questionnaires should be accurately translated into the respondents' mother-tongue. However, even in a small area there may be many languages spoken, and there is a tendency for the administration to prefer the "official" working language (often French or English) to a vernacular one. In this study, this did not seem to be a problem for the teachers, but some difficulties of comprehension might have occurred with the children. Such problems were only reported for children in Cameroon, but it should be stressed that the problem was not investigated systematically by the teams. The difficulty that arose in Ethiopia, where a majority of children did not understand "bilharzia" was not basically a linguistic one. The children came from Amharic-speaking immigrant families, and schistosomiasis was not a disease their group had been exposed to traditionally, so that they had no concept of a disease with this particular complex of symptoms, and would not have understood even if another word had been found.

The sequence of the questions was also not the same in all the countries. Within the framework of this study no experimentation was carried out on the possible influence of the order of the questions, or the number and characteristics of the items on the lists proposed for ranking. The only available experience comes from the previous Tanzanian studies, which concluded that the teachers should not be asked to rank more than 6 items (Lengeler et al., 1991b).

Another factor that was not standardized (despite an initial agreement) was the length of the recall period. Four countries used two weeks and three countries used one month. It is unlikely that this difference affected the results seriously, since schistosomiasis is a chronic disease and occurs over a long period of time. There was no control programme in any of the study areas during the period just before the study which could have affected the situation dramatically. There was a feeling among investigators that even two weeks was a long period to recall morbidity events and that one week would have been more appropriate, but no data are available to support this view.

6.2 Sampling and statistical problems

An important issue that arose during the study was the definition of "high-risk" and "low-risk" schools. This was necessary in order to select a sample of schools for biomedical testing following the completion of the questionnaires. At this point in the study, the only data available were the "positivity rates", that is, the percentages of positive answers per school. The problem was solved in a pragmatic way by calculating the median country positivity rate, and choosing schools in equal numbers above and below this value. The procedure had the advantage that it resulted in the selection of an equal number of "high-risk" and "low-risk" schools, which avoided the danger of bias in the diagnostic performance estimates (a problem that was faced by the early Kilosa study in Tanzania; Lengeler et al., 1991b).

A problem in most countries was that the teachers were not happy about the sampling procedure used to select children for biomedical testing, and would have liked to select children in a different way. The testing was clearly seen as being of benefit to the children, so the teachers had difficulty with the fact that only certain classes were to be tested. Generally, they would have preferred to test every child in the school. In Zaire, some teachers wanted the team to test selected children in every class in order to give everybody a chance. If children had been selected on the basis of reported disease, or because teachers thought they looked sick, this would have been likely to lead to an over-estimation of the prevalence rate. Fortunately, the results from all the sites suggested that in the end, the teachers had actually carried out systematic sampling in pre-set classes in the way that was required.

A general statistical problem was that many regressions were calculated with rates as the units of correlation. Formally this was incorrect, since each point had its own binomial variability. Unfortunately, the correct analysis of such data were beyond the analytical and computing capacity of the study. However, it was considered that the variabilities of all the points would tend to cancel each other out and that the resulting correlation coefficients would therefore not be affected significantly.

6.3 Interaction between social sciences and biomedical sciences

From the start, there was a strong emphasis on the importance of collecting socio-economic, anthropological, political and cost data. The study attempted to offer a framework for the interaction between biomedical and social scientists with the aim of increasing the efficacy and cost-effectiveness of health interventions. Knowledge of the human environment and of economic aspects of health problems is crucial to the operational success of both research and intervention programmes (Vlassoff, 1992), but so far examples of these interactions are rare, because of the partitioning of research and control programmes, and the excessive

specialization of scientists in general. The present study had a basically biomedical design, and largely made use of methods from the biomedical field. However, human (disease perception and prioritization), socio-political (questionnaire distribution, key informants) and financial (cost comparison) aspects were tightly woven into the study structure.

It was always stressed that the recording of social science elements should not be regarded as the exclusive duty of the social scientist on the team. Similarly, the social scientists were encouraged to participate actively in the biomedical testing. Multidisciplinary work does not only mean that people from different disciplines work in parallel on the same project, but also that they become actively involved in work in fields other than their own, so that different areas of competence can cross-fertilize each other during the working phase.

In practice, much useful information was obtained by the teams, but the interdisciplinary interaction proved to be somewhat incomplete in all countries except Zaire. Generally, the social science part of the study was the weaker one, and this was reflected in the country reports. Two main reasons for this situation were identified. Firstly, there were problems associated with the composition of the teams. There was considerable mobility among the social scientist team members; some left early or joined the study later. They were also in general less senior and experienced than the biomedical scientists. In some cases, the social scientists were demographers, and they tended to have a rather quantitative and biomedical approach which did not really complement that of the rest of the team.

The second problem was that the collection of qualitative data had not been discussed in sufficient detail at the start, and there was some confusion among the investigators as to what information was required. This was recognized at the first workshop, and additional fieldwork was carried out and specific guidelines prepared, which included the description of the instruments to be used, such as observation methods, and also instructions for the handling of large masses of descriptive material. This led to some improvement. It is recommended that in the future, such large multi-country studies should be preceded by a common research training workshop on multi-disciplinary approaches, and that comprehensive and specific guidelines should be set up, establishing the research framework and the concepts for data-collection and analysis.

6.4 Study management and general issues

The coordination unit

The coordination unit (CU) constituted a central element of initiative and support. Through its two poles - administrative and technical - it allowed the follow-up and support of the work in the seven countries and ensured that all teams reached their objectives. The broad tasks of the CU were the administrative organization; the channelling of funds; the procurement and dispatch of equipment and supplies; overall supervision and technical support; the organization of workshops and specific training; the standardization of data analysis, and the final meta-analysis. Twice (Ethiopia and Zaire) the CU had to intervene on-site in order to ensure the continuity of the study, following the abrupt departure of the country Principal Investigator. Three one-week workshops were held for the participating teams during the three years of the study. They were an essential tool for on-the-job training and coordination.

Communications

Communications are a crucial element in a multi-centre study. No special communication problems were encountered with Cameroon, Congo, Zambia and Zimbabwe, as both postal services and telecommunication worked reliably most of the time. For Ethiopia and Malawi many telecommunication problems affected the studies but the postal services, although slow, were quite reliable. Zaire presented the worst problems - the only link with the outside world during the study period was provided by travellers who agreed to carry mail personally. Nowadays, E-mail via a satellite network (SatelLife) would provide an ideal tool to overcome communication problems in a study like this one, but it was unfortunately not available early enough.

The teams of investigators

Of the 14 investigators involved at the beginning of the study in 1989, only three (21%) were still in their teams three years later. This very high rate of change (79%) caused many problems for the continuity of the work, and the CU sometimes provided the only link between successive investigator "generations". Four experienced investigators who took up a new job during the study time, and four younger ones who left for further training, contributed to this mobility. One investigator died during the period of the study.

The language problem and networking

The language barrier is one of the important factors limiting exchanges between African scientists, especially between the largely anglophone countries of the East and South, and the francophone countries in Central and West Africa. One of the objectives of the study was to investigate how this situation could be dealt with in a practical manner.

The CU dealt with all correspondence in both English and French, in order to facilitate contacts with all teams. The official language for all study documents was English. For practical reasons it was impossible to translate all documents into French, and we acknowledge the effort made by the francophone teams (Cameroon, Congo and Zaire) to deal with this situation. The present study motivated at least two investigators to take up English courses. The workshops showed that for meetings systematic translation was necessary in all plenary sessions. This slowed down the work considerably, because simultaneous translation was not available.

There is no doubt that the networking effect of the study has been considerable. Repeated contacts, during the workshops and through correspondence, have established many cross-institutional links, and ideas for future common work have emerged which we hope will one day bear fruit.

7. SUMMARY OF MAIN CONCLUSIONS AND RECOMMENDATIONS

7.1 The approach; conducting a multi-country study

- The study allowed a systematic and standardized assessment of disease endemicity and disease perception in seven places with different social, economic and ecological environments.
- Adding qualitative data collection to the basic biomedical approach was crucial for understanding the working environment and reasons for success or failure.
- The study provided important networking benefits across national boundaries (between the teams) and across disciplines (within the teams). It also revealed some of the problems that need to be considered when such integrated multidisciplinary studies are carried out.
- The study provided important and continuous hands-on training for the teams, and thus contributed to the building of research capacity in Africa.

7.2 The research questions:

Validation of the questionnaire approach

- The diagnostic questionnaire approach worked well, showing high test efficiency, in five of the seven countries (Cameroon, Congo, Malawi, Zaire, Zimbabwe) and acceptably in a sixth (Zambia). It provided a feasible, fast and cost-effective primary screening methodology for the identification of schools at high risk for urinary schistosomiasis.
- Schistosomiasis disease perception followed a similar pattern in six of the seven countries. Disease perception and the relative importance of schistosomiasis as a disease were strongly correlated with the level of endemicity.
- The diagnostic questionnaire approach could not be shown to be valid in one country (Ethiopia). The reasons for this could be related to the fact that in the study area the prevalence and intensity of the disease were low, and in addition the population was largely made up of recent immigrants from a non-endemic area. This meant that symptoms were not frequently observed, and schistosomiasis was not well known as a disease entity.
- The questionnaire approach was also tested for identifying high-risk areas for intestinal schistosomiasis in one country (Zaire), and was also found to show a high test efficiency for this purpose. This finding implies that this should be a priority area for future research work because of the important implications for control.
- In all seven countries the questionnaires could be satisfactorily distributed, completed and recovered using the existing primary education system. However, the study also

pointed out the need to explore other operational routes to reach children who do not go to school or do not attend regularly.

The reliability and feasibility of reagent-stick testing by teachers

- Teachers performed reagent stick testing in a very satisfactory way in four of the five countries in which it was done. Although a large majority of the teachers considered this work useful and compatible with their normal duties, the issue of getting a payment for the reagent stick work was raised by a significant number of teachers in four countries. This is an element which will clearly have to be considered when aiming at integrating this approach into district health programmes.

7.3 The questionnaire approach in the control of urinary schistosomiasis

- The diagnostic questionnaire approach, followed by reagent-stick testing by teachers, could form the basis of a district-based priority-oriented control programme. In a first step communities with a high endemicity level could be rapidly and inexpensively identified using questionnaires. In a second step, the control strategy could either involve mass treatment (of schoolchildren or the whole community), or selective chemotherapy based on the identification of infected individuals by reagent-stick testing.
- Questionnaires do not only allow the assessment of the prevalence of schistosomiasis in a community, but also the collection of data on the way in which the disease is perceived, and its importance to the community in relation to other problems. This knowledge should allow disease control programmes to make plans that incorporate the perceived needs of the population concerned. It could also help in the setting of thresholds for different prevalences of intervention (treatment through health services, selective or mass chemotherapy).

7.4 The questionnaire approach in the control of other diseases

- The questionnaire approach can provide information about problems other than schistosomiasis, and their importance as perceived by the community, which can be useful for overall health planning.
- The findings of the present study show that the potential of the questionnaire approach should be assessed for other diseases and conditions with characteristics that allow them to be clearly and specifically perceived by the members of the community.



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APPENDICES

Appendix 1: 1a: Schoolchildren's questionnaire, Tanzania
1b: Head teacher's questionnaire, Tanzania

Appendix 2: 2a: Schoolchildren's questionnaire, Zaire
2b: Head teacher's questionnaire, Zaire

Appendix 3: Schoolchildren's questionnaire, Cameroon

re 2: Questions concerning the health of pupils

Put a mark ☒ for "yes" or a ☐ for "no" and a dash ☐ - If the child does not remember or can not answer. You have to answer the following questions. Each box is for only one child. If the boxes are not enough on one page, use the back. Return this sheet to the Headteacher. Thank you !

not enough on one page, use the back. Return this sheet to the Headteacher. Thank you !

Use only for class I, III and V Class

[illegible]

Which of the following symptoms did you experience during the last month?
Put a mark ☒ or a ☐ or a ☐ in the boxes in front of corresponding symptoms

[illegible]

Which of the following diseases did you experience during the last month?
Put a mark ☒ or a ☐ or a ☐ in the boxes in front of the corresponding

Malaria
Diarhoea
Skin diseases
Eye diseases
Schistosomiasis
Respiratory Infect.
Horms
Abdominal problems

District Education Office - Kilosa District

HEALTH SITUATION IN THE SCHOOLS OF THE KILOSA DISTRICT

Questionnaire 1: To be filled in by the Headteacher

INTRODUCTION:

The purpose of this questionnaire is to assess the health situation in the schoolchildren of the Kilosa District. There are two questionnaires to fill in. The first is this one, to be answered and filled by the headteachers. Please write down the answers according to your experience of the health of the pupils. Read the whole questionnaire once through before starting to fill it.

The second one is to be answered by all schoolchildren of Standard 1, 3 and 5 only. One teacher per class should ask every student personally and separately from the others about 8 diseases and 8 major symptoms (listed on the second questionnaire) that the child might have experienced in the last month. Put a (✓) if the answer is "yes", a (o) if the answer is "no" and a (-) if the child doesn't remember or can not answer.

After completion, please return the forms to the District Education Office, Kilosa, before August 12.

Thank you for your help!

Name of school: _____ Division: _____

Village: _____ Ward: _____

QUESTION 1:

Among the following list of diseases, please choose the six diseases that are most affecting the children of your school and rank them according to their importance.

The diseases are: disease of the abdomen, diarrhoeal disease, malaria, skin disease, eye disease, schistosomiasis, upper respiratory tract infection, measles, nutritional problem, worms.

Rank 1 _____

Rank 2 _____

Rank 3 _____

Rank 4 _____

Rank 5 _____

Rank 6 _____

QUESTION 2:

Among the following list of symptoms, please choose the 6 most frequent ones and rank them according to their importance.

The symptoms are: cough, itching, headache, fever, abdominal pain, wounds, blood in urine, joint pains, blood in stool, diarrhoea, convulsions.

Rank 1 _____

Rank 2 _____

Rank 3 _____

Rank 4 _____

Rank 5 _____

Rank 6 _____

QUESTION 3:

Among the health problems affecting the schoolchildren, which ones should be tackled first? Try to rank the 6 most important.

Rank 1 _____

Rank 2 _____

Rank 3 _____

Rank 4 _____

Rank 5 _____

Rank 6 _____

QUESTION 4:

What are the main problems affecting your village? Please rank 6 of them by order of importance.

The problems are: clean water, agricultural services, availability of goods, health problems, transport, sanitation, education, food, better housing, milling machine, other.

Rank 1 _____

Rank 2 _____

Rank 3 _____

Rank 4 _____

Rank 5 _____

Rank 6 _____

QUESTION 5:

What water points do the people use in the village? Try to rank the following according to their use in the village: wells, ponds, hand pumps, rivers, tap water, other.

Rank 1 _____

Rank 2 _____

Rank 3 _____

Rank 4 _____

Rank 5 _____

Rank 6 _____

Thank you for your help!

District Education Officer
Kilosa District, Kilosa.

UWAK 3, 7/88.

QUESTIONNAIRE 2 : QUESTIONS POSEES AUX ECOLIERS

nom de l'école : _____ nom du village : _____ nom du groupement : _____

classe (cocher la case correspondante) :

4eF

Sep

6EP

Instructions : Le Maître interrogera chaque élève de sa classe séparément et lui demandera s'il a eu au cours du dernier mois les symptômes et les maladies citées plus bas.

Mettre ☒ pour "Oui" ou ☐ pour "non" ou un ☐ si l'enfant ne se souvient pas ou ne

peut pas répondre. Chaque colonne correspond à un enfant. Utilisez le verso de la feuille si le nombre de colonnes n'est pas suffisant. Prière de retourner cette feuille remplie au Directeur de l'école. Merci pour votre collaboration.

[illegible]

L SYMPTOMES

[illegible]

2. MALADIES

[illegible]

INSTRUCTIONS :

L'objectif de ce questionnaire est l'évaluation de la santé des écoliers de la zone de Songololo. Il y a deux questionnaires à remplir.

Le premier questionnaire concerne les Directeurs d'Ecoles qui devront le remplir. Notez s.v.p. les réponses, selon votre expérience, en ce qui concerne la santé des élèves. Avant de répondre au questionnaire, lisez-le en entier et attentivement.

Le deuxième questionnaire concerne chaque écolier de 4e, 5e et 6e primaires. Par classe, chaque écolier sera interrogé personnellement et séparément par son maître. L'écolier sera interrogé à propos des maladies et des symptômes majeurs qu'il (elle) aura eu pendant le dernier mois. Les réponses de tous les écoliers d'une classe seront inscrites sur une seule feuille de questionnaire selon les instructions mentionnées. Après avoir rempli les 2 questionnaires retenez-les s.v.p. à l'inspecteur du pool dans les meilleurs délais.

Merci beaucoup pour votre collaboration !

QUESTIONNAIRE 1: QUESTIONS POSEES AUX DIRECTEURS D'ECOLE

nom de l'école :
 nom du village :
 nom du groupement :
 nom de la collectivité:

1. Classez, dans la liste suivante, les 6 symptômes qui vous semblent être les plus fréquemment rencontrés chez les écoliers de 10 à 18 ans dans votre école. (Numérotez de 1 à 6, 1 représentant le symptôme le plus fréquemment rencontré).

fièvre mal de tête
 plaies toux
 douleurs en urinant diarrhée
 sang dans les selles sang dans les urines
 douleurs aux articulations mal de ventre
 démangeaisons convulsions

2. Classez, dans la liste suivante les 6 maladies qui vous semblent être les plus fréquemment rencontrées chez les écoliers de 10 à 18 ans dans votre école. (Numérotez de 1 à 6, 1 représentant la maladie la plus fréquemment rencontrée).

paludisme maladies de la peau
 maladies des yeux vers intestinaux
 bilharziose diarrhée
 grippe maladies respiratoires
 filaires malnutrition
 maladies digestives maladie du sommeil

3. Parmi les problèmes de santé qui affectent le plus les écoliers, lesquels résoudre en priorité ? Enumérez les 6 problèmes les plus importants (1 représentant le plus important) :

1
 2
 3
 4
 5
 6

4. Quels sont les problèmes de développement les plus importants pour votre école parmi ceux énumérés ci-après; classez-les par ordre d'importance (1 représentant le plus important).

Liste de problèmes : eau potable, services agricoles, manque de médicaments, manque de structures de santé, transport, écoles, manque de nourriture, logement, manque de moulins, hygiène.

1
 2
 3
 4
 5
 6

5. Classez, de 1 à 8 les modes d'approvisionnement en eau les plus utilisés dans votre école (1 représentant le mode le plus fréquent) :

robinet sources marigot puits
 borne fontaine ruisseau ou rivière lac
 eau de pluies

6. Enumérez les structures de soins près ou dans votre école. (cochez la ou les cases correspondantes)

tradi-praticien (guérisseur) agent de santé
 dispensaire hôpital

MERCI POUR VOTRE COLLABORATION !!

QUESTIONS POSEES
AUX ECOLIERS

nom de l'école:_____

nom du village:_____

âge: classe (*):

CE2(1)

CM1(2)

 sexe (*):

M(1)

F(2)

Symptômes ? (au cours des 15 derniers jours)	O pour Oui N pour Non	traitement O pour Oui N pour Non	où le traitement a-t'il été prescrit ? (M/G/C/D/H)
fièvre.....	<input type="checkbox"/>
mal de tête.....	<input type="checkbox"/> M: à la maison (par des parents)
toux.....	<input type="checkbox"/> G: chez le guérisseur
démangeaisons.....	<input type="checkbox"/> C: à la case de santé
mal de ventre.....	<input type="checkbox"/> D: au dispensaire
douleurs aux articulations	<input type="checkbox"/> H: à l'hopital
sang dans les urines.....	<input type="checkbox"/>
amaigrissement.....	<input type="checkbox"/>
douleurs en "pissant".....	<input type="checkbox"/>
diarrhée.....	<input type="checkbox"/>
sang dans les selles.....	<input type="checkbox"/>
jaunisse.....	<input type="checkbox"/>

maladies ? (au cours des 15 derniers jours)	O pour Oui N pour Non	traitement O pour Oui N pour Non	où le traitement a-t'il été prescrit ? (M/G/C/D/H)
paludisme.....	<input type="checkbox"/>
maladies de la peau.....	<input type="checkbox"/>
rougeole.....	<input type="checkbox"/>
bilharziose.....	<input type="checkbox"/>
vers intestinaux.....	<input type="checkbox"/>
filaires.....	<input type="checkbox"/>
maladies des yeux.....	<input type="checkbox"/>
grippe.....	<input type="checkbox"/>
maladies digestives.....	<input type="checkbox"/>

Page (1): (1) (2)

Le traitement a-t-il
été prescrit ?

(N/C/S/H)

- ... N: à la maison
- ... (par des parents)
- ... S: chez le
médecin
- ... C: à la casé de
santé
- ... H: au dispensaire
- ... H: à l'hôpital

... les réponses inutiles

